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A STUDY OF SOME RELATIONSHIPS BETWEEN MANDIBULAR PROGNATHISM AND SOMATOTYPE

by

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Submitted in partial fulfillment of the requirements

for the Degree of Master of Science

Department of Orthodontics

WESTERN RESERVE UNIVERSITY

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INTRODUCTION

Patients with a severe mandibular prognathism are disturbing problems for the orthodontist and the oral surgeon. The treatment of this type of patient challenges the experienced clinician and has long been the subject of much research. This patient often seeks consultation for correction of facial esthetics and improvement of dental occlusion while still in his growth period. The practitioner is then faced with the problem of determining how and when this patient should best be treated.

Most researchers would probably agree that the prognathic mandible may develop from a variety of factors. These factors may range from dominant genetic characters through a multitude of intraoral phenomena and are influenced by various extrinsic problems such as enlarged tonsils and adenoids, mouth breathing and anatomical positioning of the hyoid bone.

If there are common causes for mandibular prognathism, then indeed it may be possible that these people have other characteristics in common such as body build, dysplasias of body parts, habit patterns and genetic history.

Somatotyping is a quantitative description of the morphological structure of an individual. In recent years, the field of somatotyping has developed into a promising method of research for

growth and development studies. The procedures and methods have been standardized, extensive studies on large populations have been conducted, and many useful observations have resulted. There is good reason to believe, or at least suspect that there exists a definite correlation between an individual's somatotype and his psychological make-up, his predisposition to disease, and his basic physical development (1).

This study was designed to determine if there is a correlation between somatotype and Class III mandibular prognathism. A gross comparison of somatotype to degree of mandibular prognathism will be made. The single measurements used in determining the somatotype will then be presented on deviation charts to show body dysplasia.

Additional measurements taken from cephalometric roentgenograms will be compared by statistical analysis to the mandibular prognathism measurements. Patients' histories and skeletal ages will also be analyzed for significant findings.

REVIEW OF THE LITERATURE

Writings that pertain directly to a comparison of somatotype with dental occlusion are not abundant in the literature. Discussions on body build per se begin as far back as Hippocrates and they became more numerous and varied as time progressed. The investigators of mandibular prognathism are extremely numerous in the dental literature. Complete coverage of these two related subjects is beyond the scope of this paper and it will therefore be limited to selected writing that will aid in an understanding of this study.

Since the historic works of Hippocrates (460-400 B.C.) in which he described two body types, the Habitus apoplecticus or short stocky build and the Habitus phthisicus or long thin build, there have been a great number of investigators of body build. The names of Rostan, deGiovanni, Viola and Kretschmer should be mentioned as the most outstanding of the early investigators. Their work, along with that of many others, is reviewed in detail in Sheldon's historical review (2).

Kretschmer (3) was probably the first to give a detailed analysis of three types of body build. His was a comprehensive study and related three body types, asthenic, pyknic, and

athletic. He also related these types to certain endogenic psychoses.

Sheldon (4) (1940), expanded the studies of Kretschmer and others. He developed a very precise classification with three components for each subject; endomorphy, mesomorphy, and ectomorphy. The principle element of each component are derived from the respective embryonic germ layers. He further quantified each component on a 7-point scale. He then described the system of components as being interrelated, each individual having a value for each component and the three values totalling between 9 and 12. The total value stays in this range because of the inverse relationship of the components. As one increases toward the maximum the other two decrease. Sheldon (5) (1954) also published a somatotyping text, "Atlas of Men," a very complete photographic classification of the different somatotypes, which is used by most somatotyping investigators today.

Parnell (6) expanded some of Sheldon's ideas on behavior and physique and discussed the advantage of integrating anthropometric measurements into the somatotyping procedures.

Tanner (7) published a book covering an excellent study he conducted on Olympic athletes showing the correlation between the somatotype and the particular athletic event the individual participated in.

In 1947, Ryan (8), in his book, "Psychobiologic Foundations in Dentistry," presented a psychological explanation of the personality ambitions and ability to accomplish in each of the three

components described by Sheldon. He goes on to relate the probable patient characteristics exhibited by people in each of the components and is careful to explain that every individual is a combination of all three components, that all individuals are different and that the dentist should treat the complete person, not his dental disease.

In studying the mandible and its relationship to the maxilla, the work of Angle (9) (1899) is basic. He was probably the first to make a complete study and classification of this relationship and present it in a simple useful manner. Angle's classification of malocclusion has stood the test of time, but his developmental etiology theory on the growth of the mandible was superceded by the work of Broadbent (10) in 1937.

Broadbent developed the first scientific cephalometric x-ray technique and conducted excellent longitudinal growth studies to determine the growth patterns of the normal face.

Strang (11) discusses the etiology of the prognathic mandible and includes, as do most other clinicians, inherited factors, glandular unbalance and perverted muscular actions.

An excellent study was recently published by Bjork (12) on the growth pattern of the mandible. He conducted a longitudinal study utilizing metallic implants in the mandible to orient a series of radiographs. This method elucidated the suspected great individual variation in mandibular growth patterns. He found that there was a complete range of growth from extreme vertical to extreme sagittal yielding gonial angle measurements from 87 degrees

to 152 degrees.

Studies relating body build to dental occlusion have been conducted by a team of Italian orthodontists over the past 30 years. Under the direction of Muzj and Maj (13) they compiled vast number of measurements, both anthropometric and cephalometric in their comparisons of occlusion and body measurements. They found that a stocky somatotype had a low wide face, a rectilinear profile, and dental arches with a large radius of curvature. The slender person has the narrow face, very angular fronto-nasal profile, and an arch reduced in the transverse dimension. These findings were supported by co-workers Adorni and Luzj.

In 1950, Lindegard (14) conducted a rather extensive study using x-ray cephalometry and a "somatometry" technique for body build which is similar to somatotyping. He devised a different method of describing individual body build according to the variables; length, sturdiness, muscle, and fat factors. He concluded that there is a relationship between these factors and measurements made on the cephalometric x-ray of the head.

Bjork (15), in 1955, combined parts of Lindegard's thinking with Sheldon's classification. His findings are most interesting. The more pertinent ones are as follows:

1. Predominance of the third component (ectomorphy) in body build is found to be associated with tooth crowding, predominance of the second component (mesomorphy) with tooth spacing.

2. Skeletal sturdiness is accompanied by a tendency to buccal occlusion, slenderness to lingual occlusion (cross bite).

3. The effect of orthodontic treatment in children is found to be significantly related to the skeletal development in sturdiness. Sturdy built children were found to respond better to orthodontic treatment (bite rising) than slender built children. This is explained by a greater growth activity in sturdy children.

Krogman and Sassouni (16) in their syllabus in Roentgenographic Cephalometry, give a rather complete analysis on the constitutional approach of studying the individual. In reviewing many anthropologic studies, they concluded that most of them did find a correlation between cephalo-facial structure and body build, that a slender build was linked with a long narrow head and high narrow face. The stocky build was found to be linked with a broad head and broad face. Krogman and Sassouni summarized their coverage of constitutional analysis with the following statement, "At present it seems warranted to conclude that correlations between head-face and body build do exist. They are useful but not definitive. One might suggest, in this connection, that Scammon has shown that upper face follows his neural growth curve, lower face his general or body growth curve. In this sense, the entire face reflects a constitutional endowment of differential growth time: more rapid and earlier completed in upper face, less rapid and completed later in the lower face. Thus, orbital and nasal root areas have one growth tempo, mid-face plus dento-mandibular another."

SECTION NO. I: SOMATOTYPE COMPARISONS

For the purpose of clarity, this study will be discussed in two sections. The first section will be Somatotype Comparisons, a gross correlation of the Class III mandibular prognathism sample with a random normal population sample. The somatotype of the two samples will be compared on a somatotype distribution chart and profile (percent deviation) chart. The second section will consist of single measurement analyses made on selected measurements extracted from the somatotyping procedure, cephalometric roentgenographs of the head, skeletal age determination from wrist x-rays and patient histories. This section will include only the mandibular prognathism sample.

Methods and Materials

The individuals in the mandibular prognathism sample were selected from the Orthodontic Clinic of Western Reserve University School of Dentistry and several private orthodontic practices in the Cleveland area. The sample consists of 14 males and 15 females. Their ages range from 13 years to 31 years and they were selected from an all white population. The control sample is made up of the fifth and sixth grade population of the Greenfield Village Elementary School at Dearborn, Michigan. It is an all white sample consisting

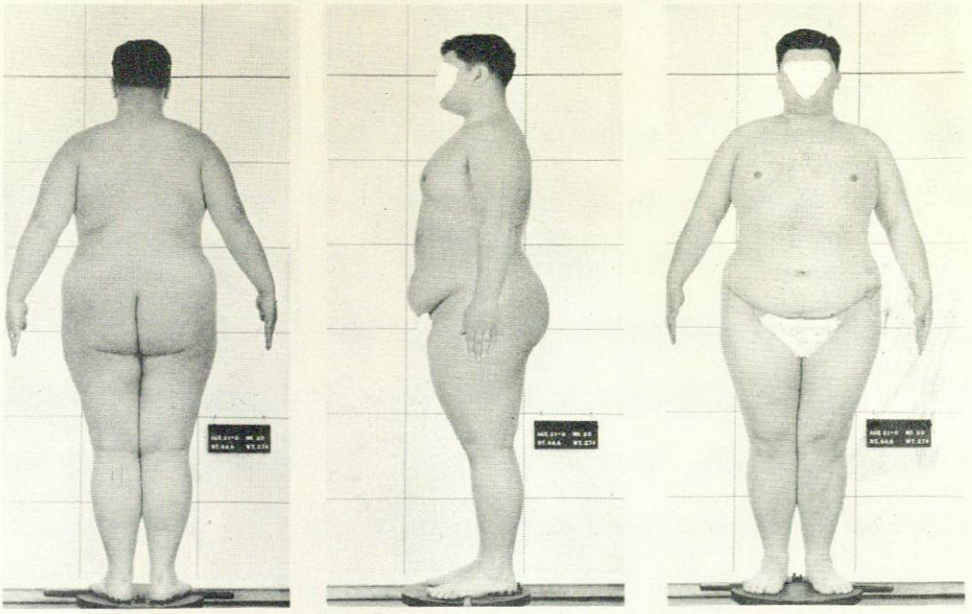
of 23 males and 25 females. Their ages range from 11 years to 12 years.

All members of both samples were somatotyped in the same procedure by members of the professional staff of the Laboratory of Clinical Anthropology of Western Reserve University School of Medicine. The procedure used was basically that which was devised by Dr. W.H. Sheldon and later supplemented by Dr. C. Wesley Dupertuis.

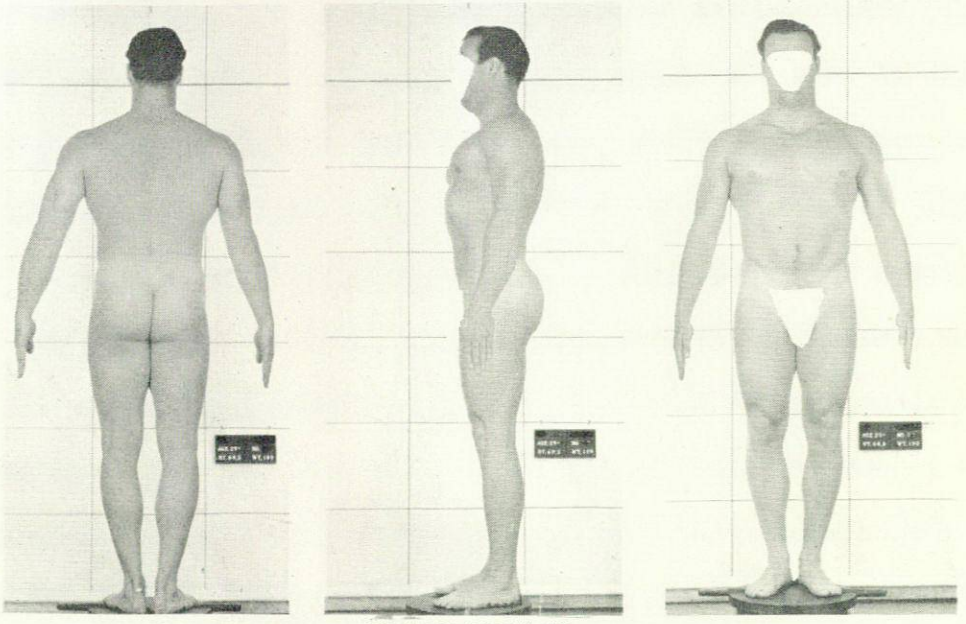
The somatotype is a quantitative rating of three components of the body structure of an individual. These components are: first, round softness (endomorphy); second, muscularity, solidity (mesomorphy); and third, linearity, fragility (ectomorphy). These three components are rated on 7-point scales where 7 represents the maximum of a component and 1 the minimum. Thus, the somatotype 7-1-1 represents the most extreme round soft, roly-poly individual (endomorphy), 1-7-1 represents the most extreme heavily muscled individual (mesomorphy), and 1-1-7 the most extreme slender delicate physique (ectomorphy). The somatotype 4-4-4 falls at the midpoint of the scale with respect to all three components. It should be remembered that the three components of the somatotype are not mutually independent, as one increases the other two tend to decrease so that a high rating in one component precludes, to some extent, high ratings in the others.

The somatotype of an individual is determined by two sets of measurements. Those made from standardized full-length nude or swimming suit photographs of the subject taken in three positions, front, side, and rear, as shown on Figure 1 and described by

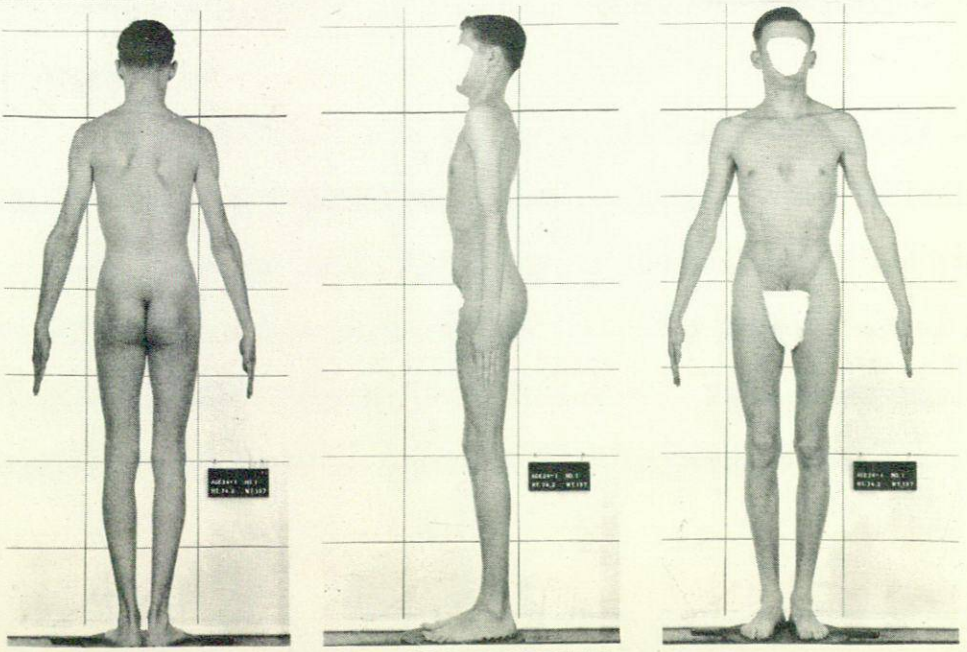
EXAMPLES OF EXTREME SOMATOTYPES



SOMATOTYPE 7-3-1



SOMATOTYPE 2-7-1



SOMATOTYPE 1-2-7

Dupertuis (17). The second set is a series of anatomical measurements made directly on the subject at the time of somatotyping. This procedure is well illustrated by Tanner (18).

The trained somatotyper can determine the individual's somatotype simply by the comparison of his photograph with Sheldon's Atlas (19) and the use of the ponderal index which is height divided by the cube root of the weight. This technique is quite subjective in nature and has therefore been modified and placed on a more objective basis by the integration of physical anthropometry (anatomical measurements) (20). These direct measurements are used to determine the amount of subcutaneous fat deposits, skeletal development, dysplasias of body parts and distribution of soft tissue. They are then arranged in a convenient index and used by the somatotyper to supplement his judgment in assessing each of the three components of the individual's somatotype. Chart 1 shows the measurements that were taken for this study. The somatotyping procedures were performed independently without the somatotyper's knowledge of the individual's degree of mandibular prognathism. The prognathism measurements were taken by the writer before the somatotypes were determined.

The mandibular prognathism of all individuals used in this study was measured directly from plaster models of the individuals' dentition. Compound bite impressions of the full upper and lower arch were taken on the control sample and from these a set of keyed articulated plaster models were constructed. Regular alginate impressions were taken of the mandibular prognathism cases. These

CHART NO. I

NAME _____ SEX _____ AGE _____ DATE _____ NUMBER _____

SKINFOLD: Iliac Crest _____

ANTHROPOMETER:

1. Stature _____cm _____in
2. Cervicale _____ _____
3. Iliac Crest _____ _____
4. Gluteal Furrow _____ _____

LARGE CALIPER:

1. Biacromial _____ _____
2. Chest Br. _____ _____
3. Bi-iliac _____ _____
4. Bitrochanteric _____ _____
5. Chest Depth _____ _____

SMALL CALIPER:

1. Face Br. _____ _____
2. Jaw Br. _____ _____

SLIDING CALIPER:

1. Elbow Br. _____ _____
2. Wrist Br. _____ _____
3. Knee Br. _____ _____
4. Ankle Br. _____ _____

WEIGHT: P.I.

Present _____ _____

Max. Wt. _____ _____
at age _____

Stat. at Max. Wt. _____

Wt. at age 18 _____

VITAL CAPACITY:

1._____ 2._____ 3._____

Percent _____

C-_____T-_____ _____ _____

BiAc_____ Chest B. _____

Biil_____ Bitro. _____

Stat._____A-_____ _____ _____

Wt. _____L-_____ _____ _____

P.I. _____H-_____ _____ _____

UTL _____ LTL_____

SIB _____

SIA _____

SIP _____

SOMATOTYPE: _____

were articulated with the aid of wax bites. The mandibular prognathism patients were selected with the aim of obtaining a sample of the most severe malocclusions in the Cleveland area. Seventeen of the twenty-nine cases had undergone surgical correction or were presently seeking such treatment. In those cases already surgically treated, the preoperative plaster models of the dentition were used. The problem of the casts being registered at one age and the somatotype at another was resolved by the unpublished work of Dr. C. Wesley Dupertuis (21) in which he showed in a longitudinal study that there is very little change in the individual's somatotype. This would be especially true in a time interval of a few years as applies in this study.

The dental occlusion measurements were taken on the plaster models with needle point dividers and recorded in millimeters of mesial or distal displacement. The displacement was measured from the "normal" relationship as defined by Angle (22). This relationship is illustrated on the plaster casts in Figure 2. The vertical marks on the first molars show a neutral relationship in which the mesial buccal cusp of the upper first molar occludes in the buccal groove of the lower first molar. Figure 3 shows a Class II or distal displacement of the mandible and Figure 4 shows a mesial or forward Class III displacement of the mandible. Figure 4 also shows the method of measuring the mandibular displacement with needle point dividers. The measurements were taken twice and on different days to reduce the possibility of error. In cases where the measurement of one side differed from the other, the most

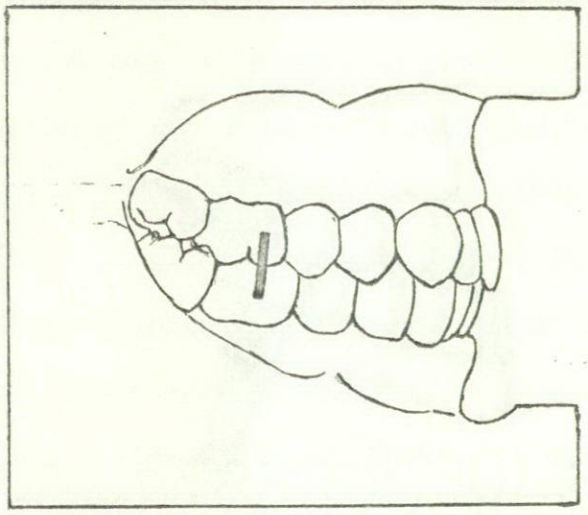


Fig. 2. Plaster casts showing "normal" dental relationship.

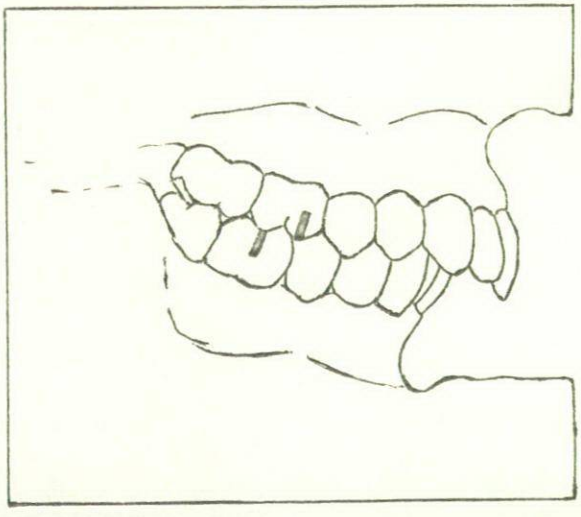


Fig. 3. Plaster casts showing class II dental relationship.

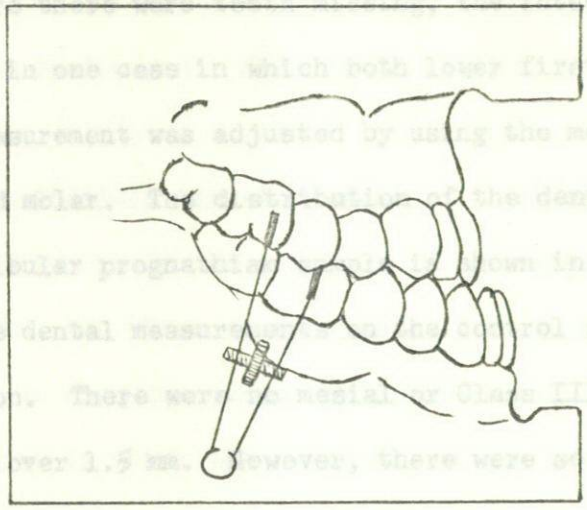


Fig. 4. Plaster casts showing class III dental relationship and method of measuring the mandibular prognathism.

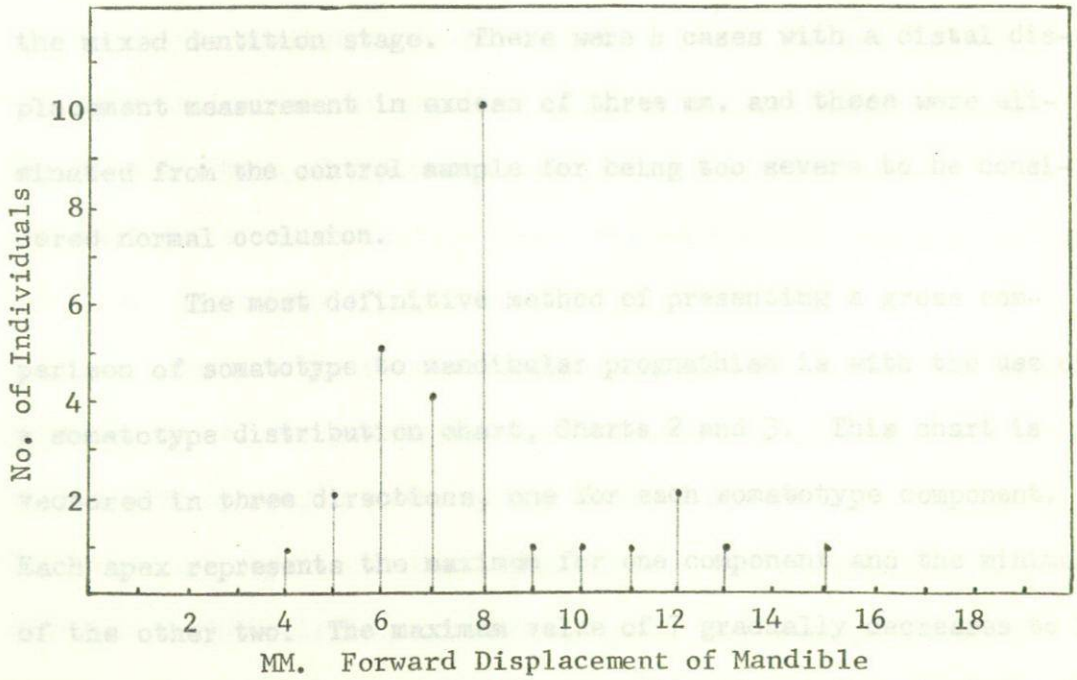


Fig. 5. Distribution of the dental measurements for the mandibular prognathism sample.

prognathic (in Class III) or most retrognathic (in Class II) side was recorded because it was found that the less extreme side usually contained blocked out, impacted or malpositioned teeth. In cases where there were teeth missing, the intact side was measured and in one case in which both lower first molars were missing, the measurement was adjusted by using the mesial distal width of the second molar. The distribution of the dental measurements for the mandibular prognathism sample is shown in Figure 5.

The dental measurements on the control sample showed much less variation. There were no mesial or Class III displacement measurements over 1.5 mm. However, there were several cases showing more severe distal or Class II displacement measurements. All cases having a distal displacement measurement of three mm. or less were kept in the sample because this was considered in the range of end-to-end molar relationship which is normal for the age group in the mixed dentition stage. There were 4 cases with a distal displacement measurement in excess of three mm. and these were eliminated from the control sample for being too severe to be considered normal occlusion.

The most definitive method of presenting a gross comparison of somatotype to mandibular prognathism is with the use of a somatotype distribution chart, Charts 2 and 3. This chart is vectored in three directions, one for each somatotype component. Each apex represents the maximum for one component and the minimum of the other two. The maximum value of 7 gradually decreases to 1 as the vector is followed to the opposite side of the chart and the

other two components increase to mid-scale of 4 or 5 because this end point for one vector is equal distance between the other two apexes. The points between the vector lines then represent an interpolation of distribution to aid the somatotyper in plotting the somatotype that doesn't fall on or close to one at the vector lines.

A statistical correlation was not determined on the comparison of the mandibular prognathism to somatotype per se for two reasons. First, the three digit figure of an individual's somatotype is not an absolute number but represents an integration of three components in which the variation of one effects the value of the others. It is therefore very difficult to use the complete three digit number and if separated into three single digits or components it loses its clarity for statistical analysis. The second reason is that after plotting the somatotype of the mandibular prognathism sample on the somatotype distribution chart, it became obvious that the correlation was not significant. For these reasons a more definitive analysis of the somatotype measurements were made and a per cent deviation or profile chart was used to analyze the somatotype more accurately.

The profile chart (Charts 4 through 32) is a graphic representation of the per cent deviation, from an established average, of the anthropometric measurements made on the subjects in the study. The zero line represents the average value of each specific measurement for individuals of that age and sex. The average values for the first three measurements, stature, weight, and ponderal index (height

divided by the cube root of the maximum weight), were derived from the standards of the Brush Foundation. This Foundation conducted a study on 1,095 Cleveland area children and the height and weight measurements were determined for each age and sex. Ponderal index is so plotted that heavier individuals, those with a low index, fall to the right side of the zero line. The remaining anthropometric measurements, have all been divided by stature in order to keep this factor constant. Each measurement is plotted as a percentage of the norm for the ratio of the measurement to stature for the subject's age and sex. All averages or norms for these measurements were taken from the unpublished data of Dr. Dupertuis. For subjects under eighteen, these values were determined from a study of over 200 children including 160 male and female teenage swimmers. For females eighteen and over, the averages were derived from 122 female college freshmen, and for males over this age, a group of 100 college freshmen were used.

The cephalometric measurements SNA, SNB, and SNPog are expressed in percent of the norms used in the Riedel analysis (23). Definitions of these landmarks and angles can be found in the first paragraph of Section II, Methods and Materials. The final item expresses the percentage of the skeletal age which the individual has attained chronologically. This item is, of course, applicable only to those subjects who have not reached maturity.

A profile chart was prepared for each member of the mandibular prognathism sample. These charts are numbers 4 through 32. The control group was not used as an average because of the age

difference and the small sample size.

In addition to the profile charts, a dysplasia rating was determined for each individual in both samples. This rating is accomplished by the somatotyper based on the comparison of body parts to an ideal standard. The range of the rating is from 1 through 7 with the average being slightly below 4 because of the skewed scale used in plotting the values. The mandibular prognathism sample was compared to the control sample and a statistical correlation was determined.

Findings and Discussion

The somatotypes of the two samples are compared according to sex and are shown on Charts 2 and 3. Chart 2 shows the distribution of the males and Chart 3 shows the distribution of the females. The control sample is plotted on the printed distribution chart and is marked with red symbols. The mandibular prognathism sample distribution will be found on the accompaning transparent overlay. Their symbols are differentiated into three groups. Each group represents a range of mandibular prognathism as determined from the plaster models of the sample. These symbols ♂, ♀ represent individuals with from 0 mm. to 6 mm. forward displacement at the mandible. These symbols ♂, ♀ represent those with from 7 mm. to 9 mm., and these ♂, ♀ show the maximum prognathism group with forward mandibular displacement of from 10 mm. to 15 mm. When using the overlays, it is necessary to superimpose the small marks at the apices of the distribution chart.

In analyzing the somatotype comparison of the two samples, the most obvious finding is the wide distribution of both samples. There is no definite grouping in either of the samples. It would be expected that the male distribution would cluster toward the center, mainly in the mesomorphic section, and the females would do

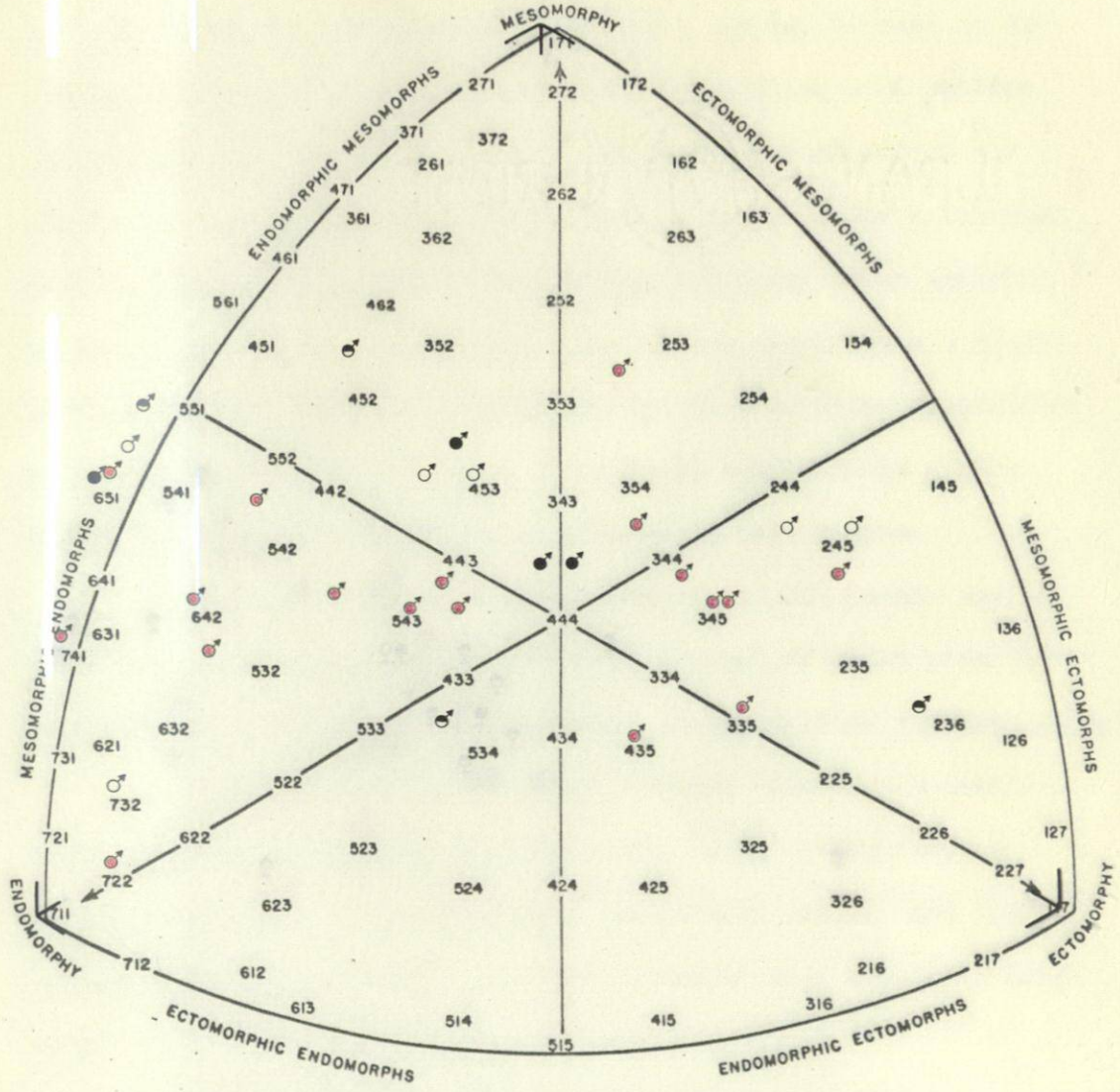


Chart 2. Somatotype distribution chart for male samples.
♂ represents one individual of the control sample.
Overlay: Somatotype distribution of the mandibular prognathism sample.
♂ represents one individual with a forward displacement of the mandible in the range of 0 mm. to 6 mm.
♂ represents one individual with a forward displacement of the mandible in the range of 7 mm. to 9 mm.
♂ represents one individual with a forward displacement of the mandible in the range of 10 mm. to 15 mm.

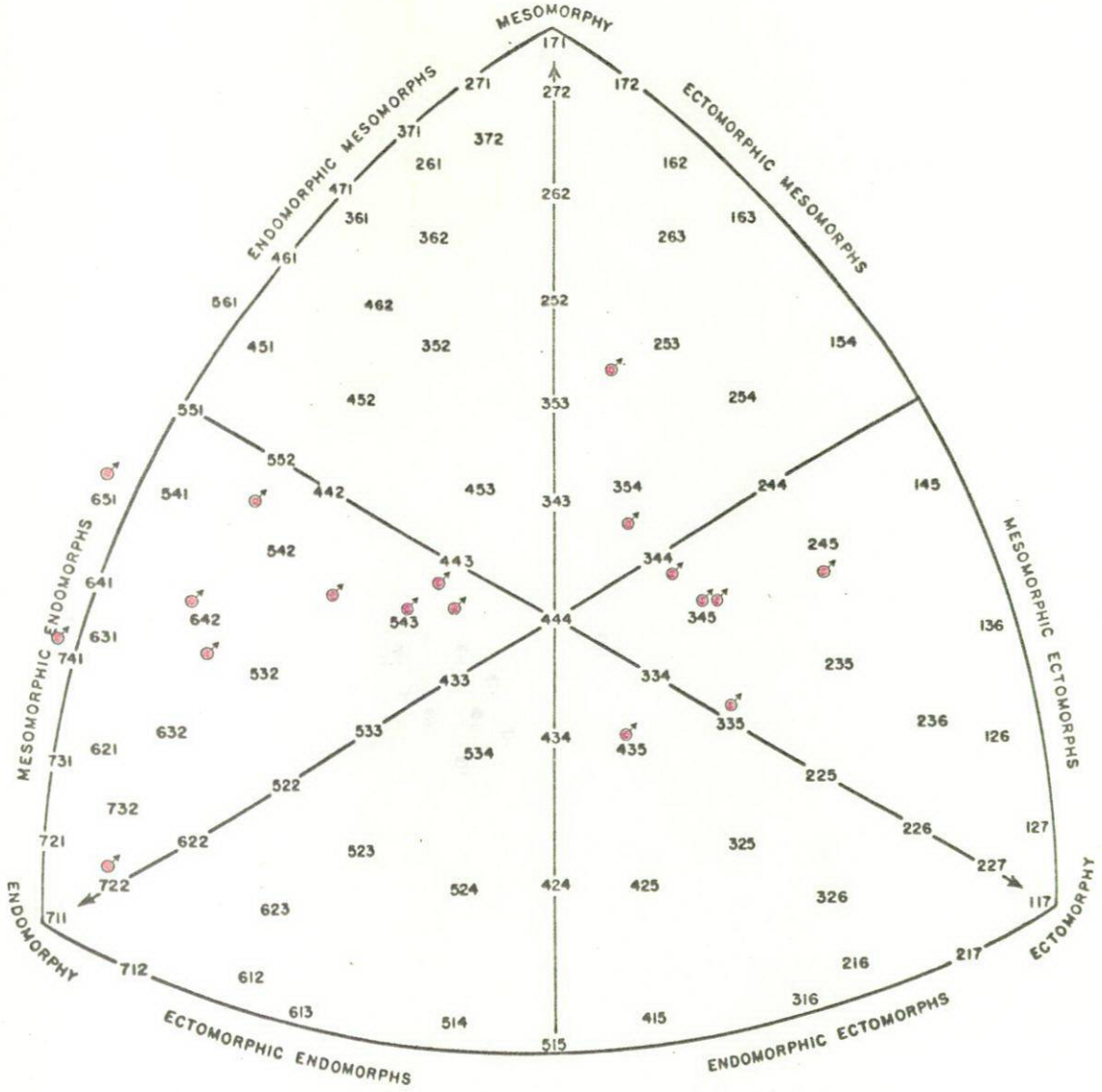


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♂ represents one individual with a forward displacement of the mandible in the range of 10 mm. to 15 mm.

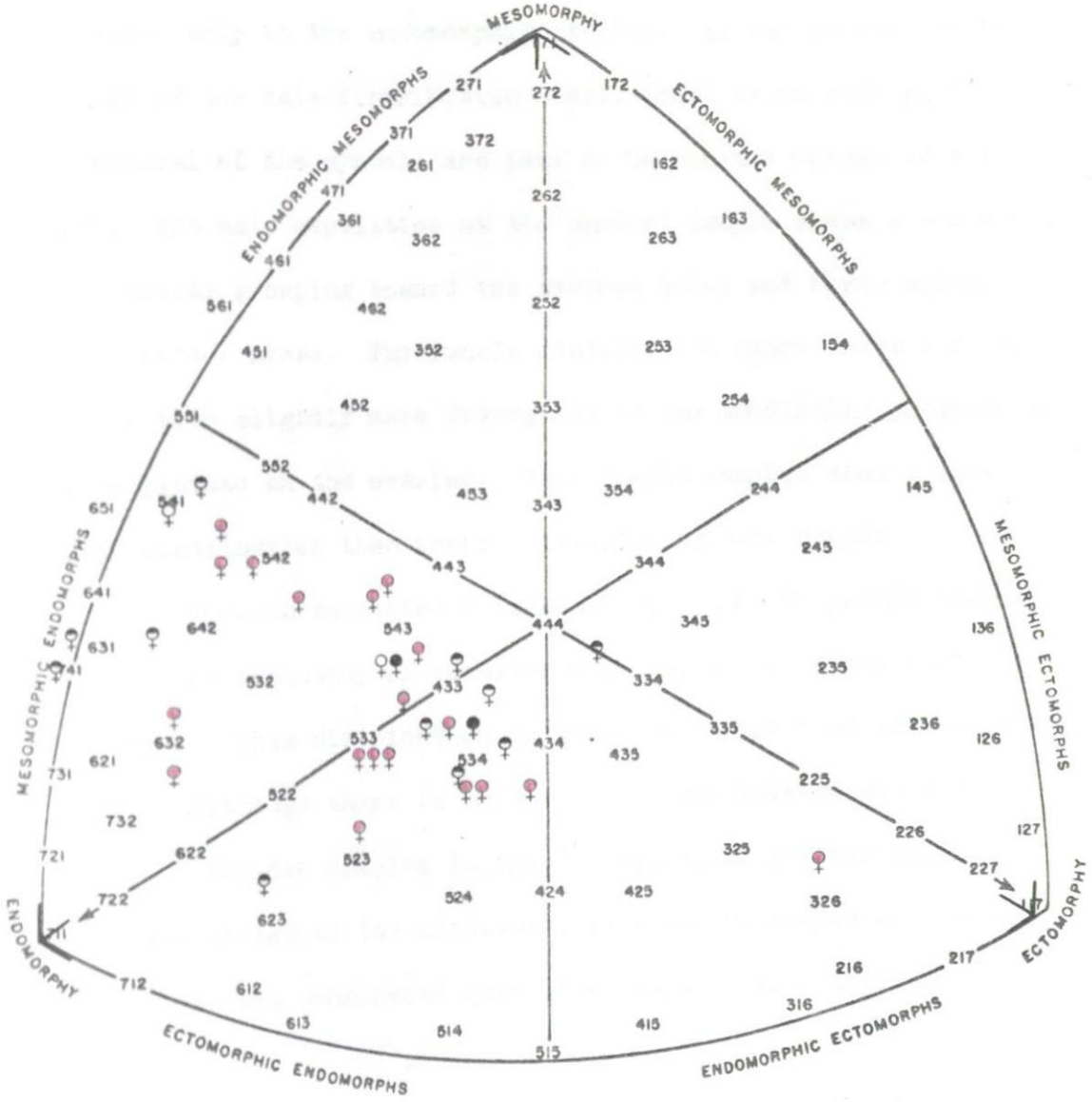


Chart 2. Somatotype distribution chart for female samples.
♀ represents one individual of the control sample.

Overlay: Somatotype distribution of the mandibular prognathism sample.
♀ represents one individual with a forward displacement of the mandible in the range of 0 mm. to 6 mm.
♀ represents one individual with a forward displacement of the mandible in the range of 7 mm. to 9 mm.
♀ represents one individual with a forward displacement of the mandible in the range of 10 mm. to 15 mm.

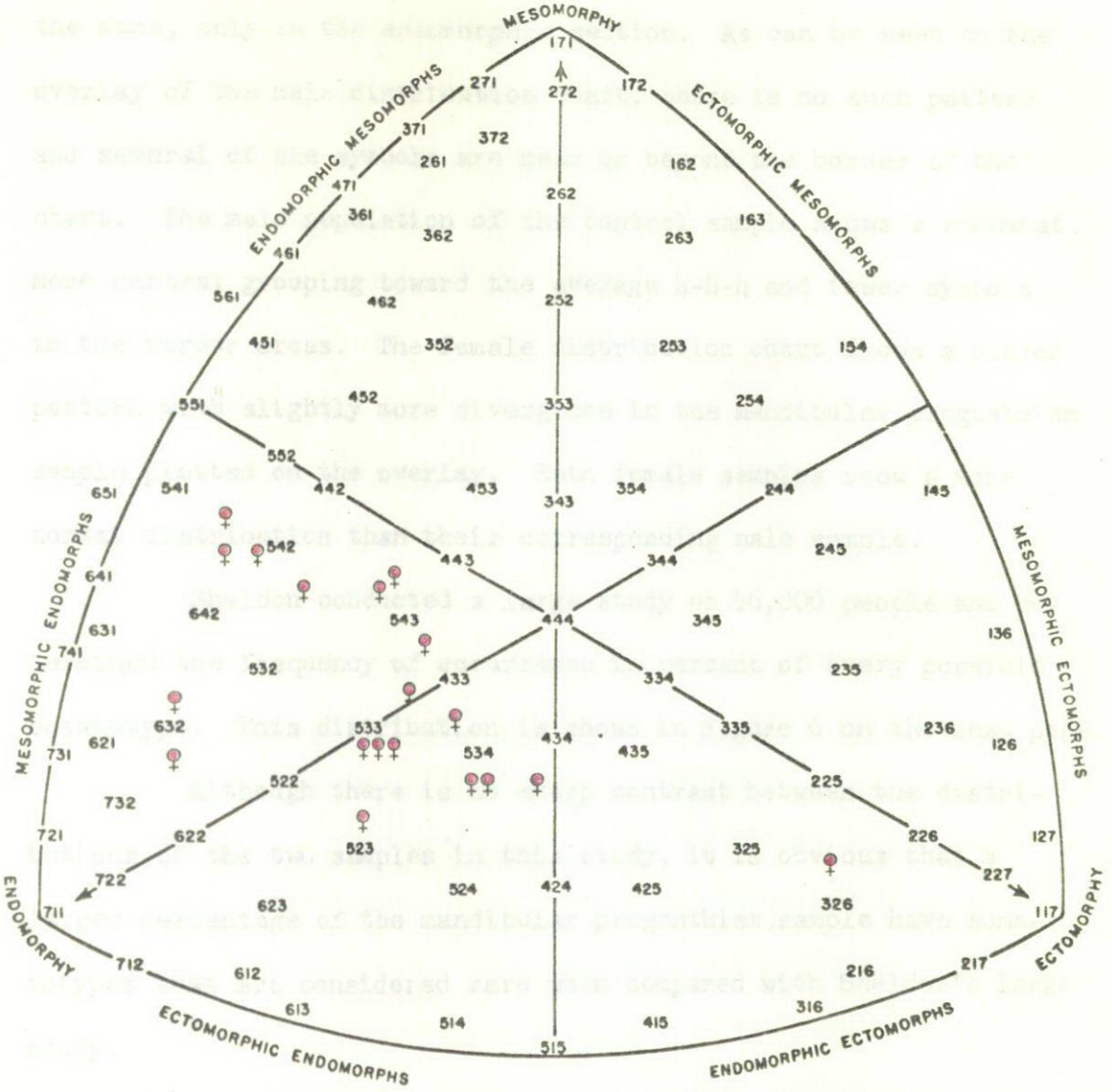


Chart 2. Somatotype distribution chart for female samples.
♀ represents one individual of the control sample.
Overlay: Somatotype distribution of the mandibular prognathism sample.
♀ represents one individual with a forward displacement of the mandible in the range of 0 mm. to 6 mm.
♀ represents one individual with a forward displacement of the mandible in the range of 7 mm. to 9 mm.
♀ represents one individual with a forward displacement of the mandible in the range of 10 mm. to 15 mm.

the same, only in the endomorphic section. As can be seen on the overlay of the male distribution chart, there is no such pattern and several of the symbols are near or beyond the border of the chart. The male population of the control sample shows a somewhat more central grouping toward the average 4-4-4 and fewer symbols in the border areas. The female distribution chart shows a closer pattern with slightly more divergence in the mandibular prognathism sample plotted on the overlay. Both female samples show a more normal distribution than their corresponding male sample.

Sheldon conducted a large study on 46,000 people and determined the frequency of occurrence in percent of every possible somatotype. This distribution is shown in Figure 6 on the next page.

Although there is no sharp contrast between the distributions of the two samples in this study, it is obvious that a larger percentage of the mandibular prognathism sample have somatotypes that are considered rare when compared with Sheldon's large study.

In determining the somatotypes of the mandibular prognathism sample, it was noted by Dr. Dupertuis that a large majority of the individuals in this group were very difficult to somatotype in comparison with a normal population. Many of the subjects exhibited a dysplasia of body parts, a dispreportionment, making it difficult to assess on the three components of normal somatotypes. Because of the high dysplasia rating and the wide range of somatotypes displayed by the mandibular prognathism sample, it became

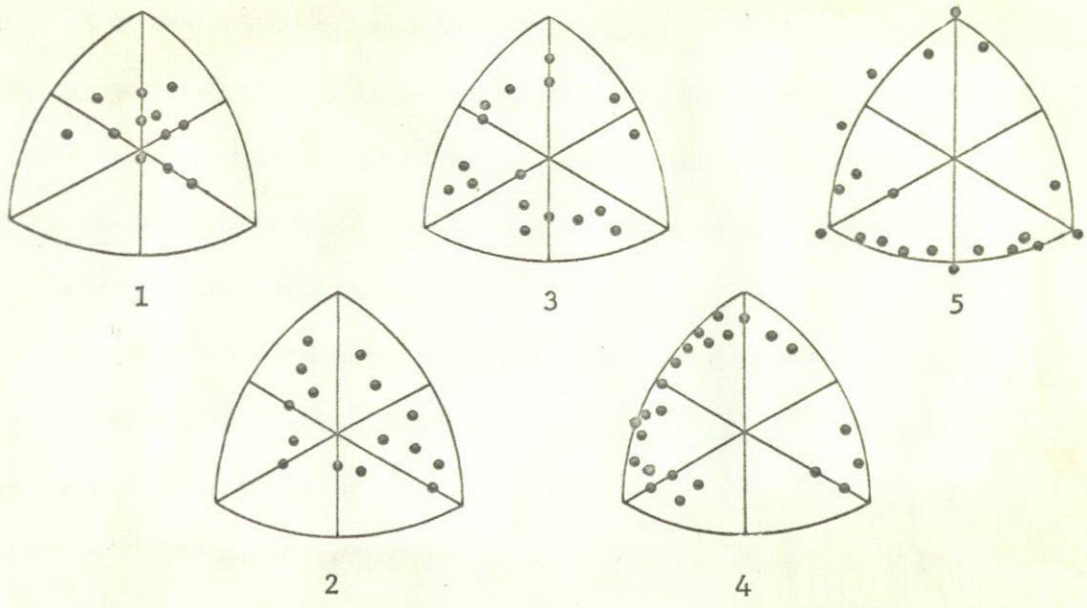


Fig. 6. Distribution charts showing the frequency of occurrence in percent of every possible somatotype.

1. Commonest Somatotypes. These 12 somatotypes include 52.2% of the male population.
2. Less Common Somatotypes. These 15 somatotypes include 31.0% of the male population.
3. Scarce Somatotypes. These 17 somatotypes include 10.6% of the male population.
4. Very Scarce Somatotypes. These 24 somatotypes include only 5.4% of the male population.
5. Rare Somatotypes. These 20 somatotypes include only 0.8% of the male population.

apparent that an individual analysis, using single measurements would be the most significant method to compare this sample to an established norm. A profile chart (Charts 4 through 32), showing the percent deviation for each measurement, was plotted for each individual in the test sample. It would be expected that most individuals would register some deviation because of the great individual variation. However, a well proportioned person should have

a consistent percentage deviation either greater or less than the zero or average line. On examination of the profile charts for this sample, a great deal of variation can be noted. The values not only fluctuate in degree of percent deviation, but very frequently reverse direction crossing the zero line showing an opposite deviation in different body segments.

With the exception of the gluteal furrow and cephalometric measurements, there is little consistency among all individuals in the sample. Like the somatotype distribution, the profile charts show a wide range of variation. The most significant observation is that most of them have a high number of rather gross deviations. This can best be illustrated by a comparison dysplasia rating.

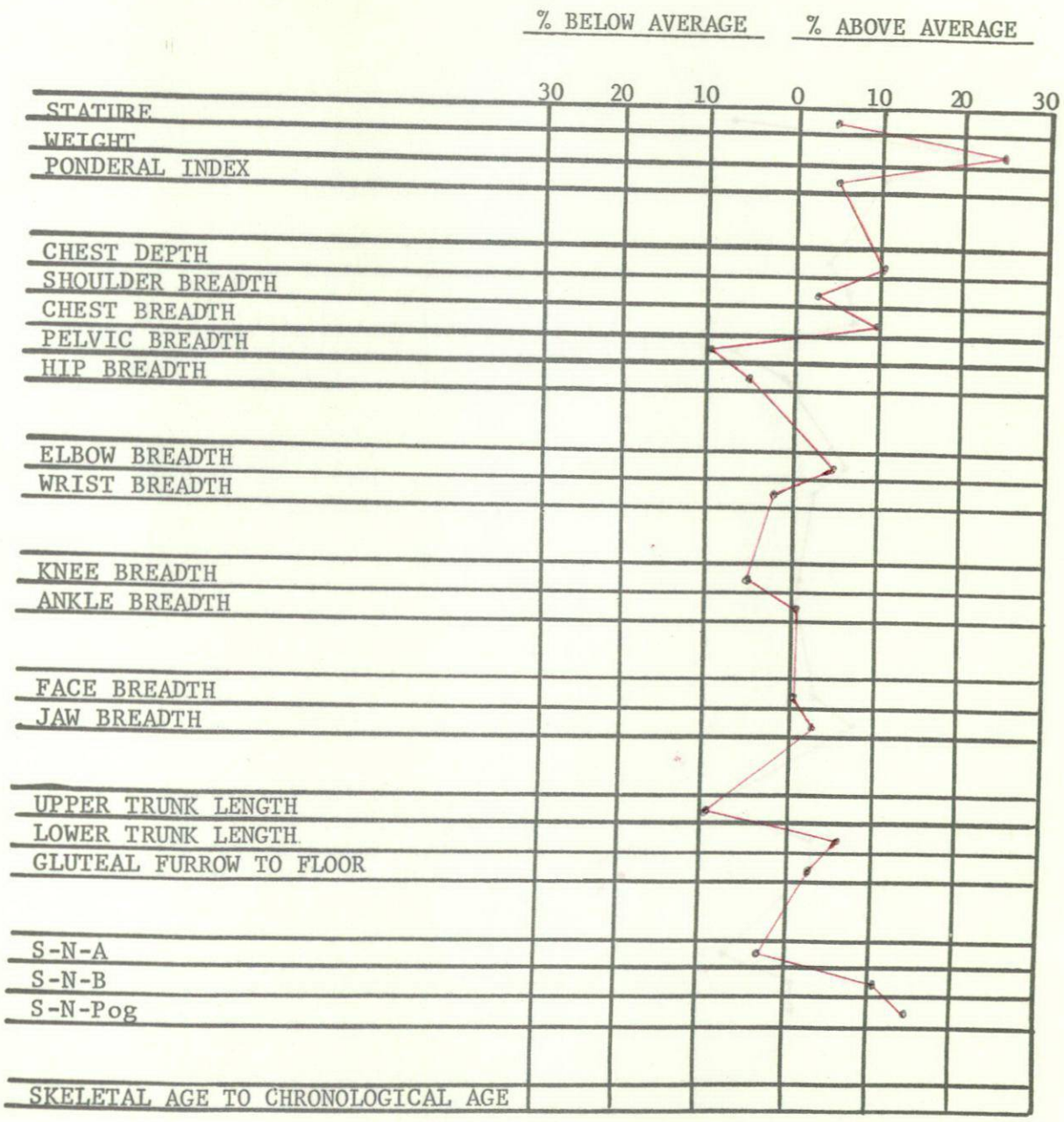
The dysplasia ratings were determined by Dr. Dupertuis for both samples in the study. The mean for the control sample was 3.38 or slightly below average on the 7-point scale used in this rating. The standard deviation was 0.841 and a standard error of the mean was determined to be 0.12. The mandibular prognathism sample had a mean rating of 4.31 which is 0.93 higher than the control sample. The standard deviation was 1.26 and the standard error of the mean was 0.24 which is double that of the control group indicating a much greater variability. According to statistical methods (see Methods and Materials, Section II), this analysis yields a T value of 3.42 and a probability $p < .01$. This suggests a high correlation between an increased dysplasia rating and mandibular prognathism. However, the degree of prognathism was not directly related to an increase in the dysplasia rating.

PROFILE CHART # 4

Pt. No. 1 J.M.

Male 25 years

Mandibular Prognathism 12 mm.

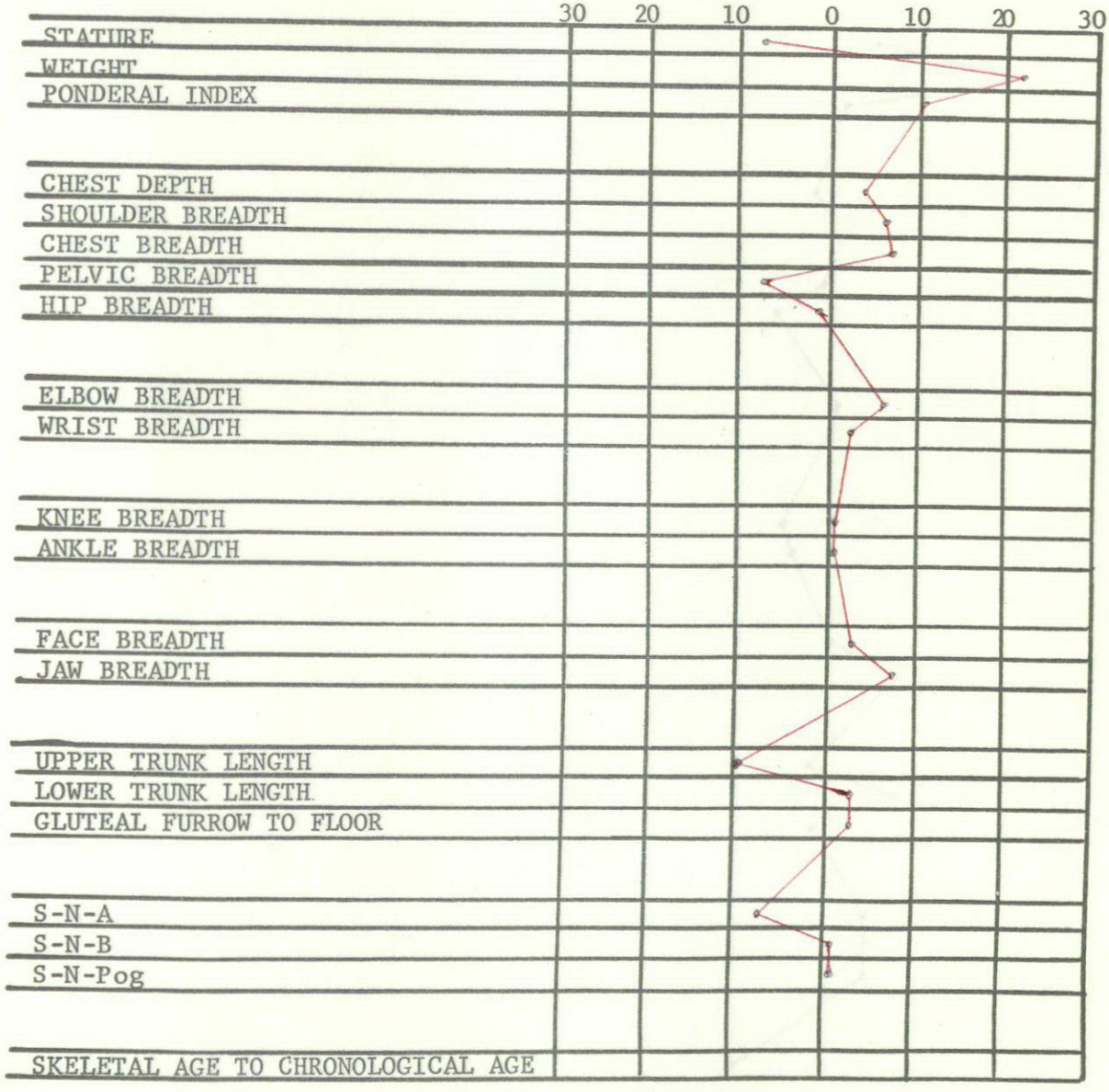


PROFILE CHART # 5

Pt. No. 2 D.T.

Male 21 years

Mandibular Prognathism 13 mm.

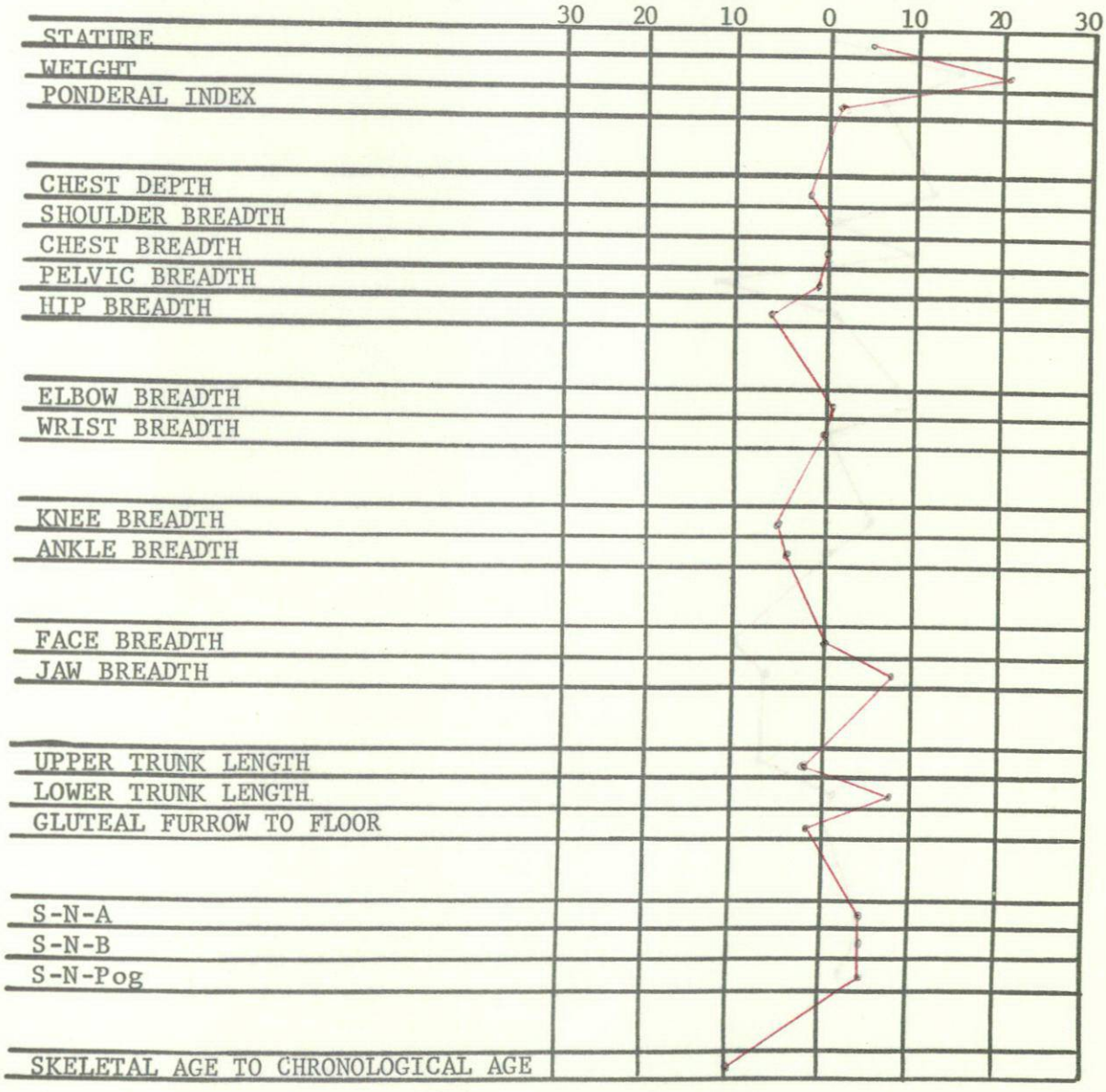


PROFILE CHART # 6

Pt. No. 3 J.B.

Male 17 years

Mandibular Prognathism 6 mm.

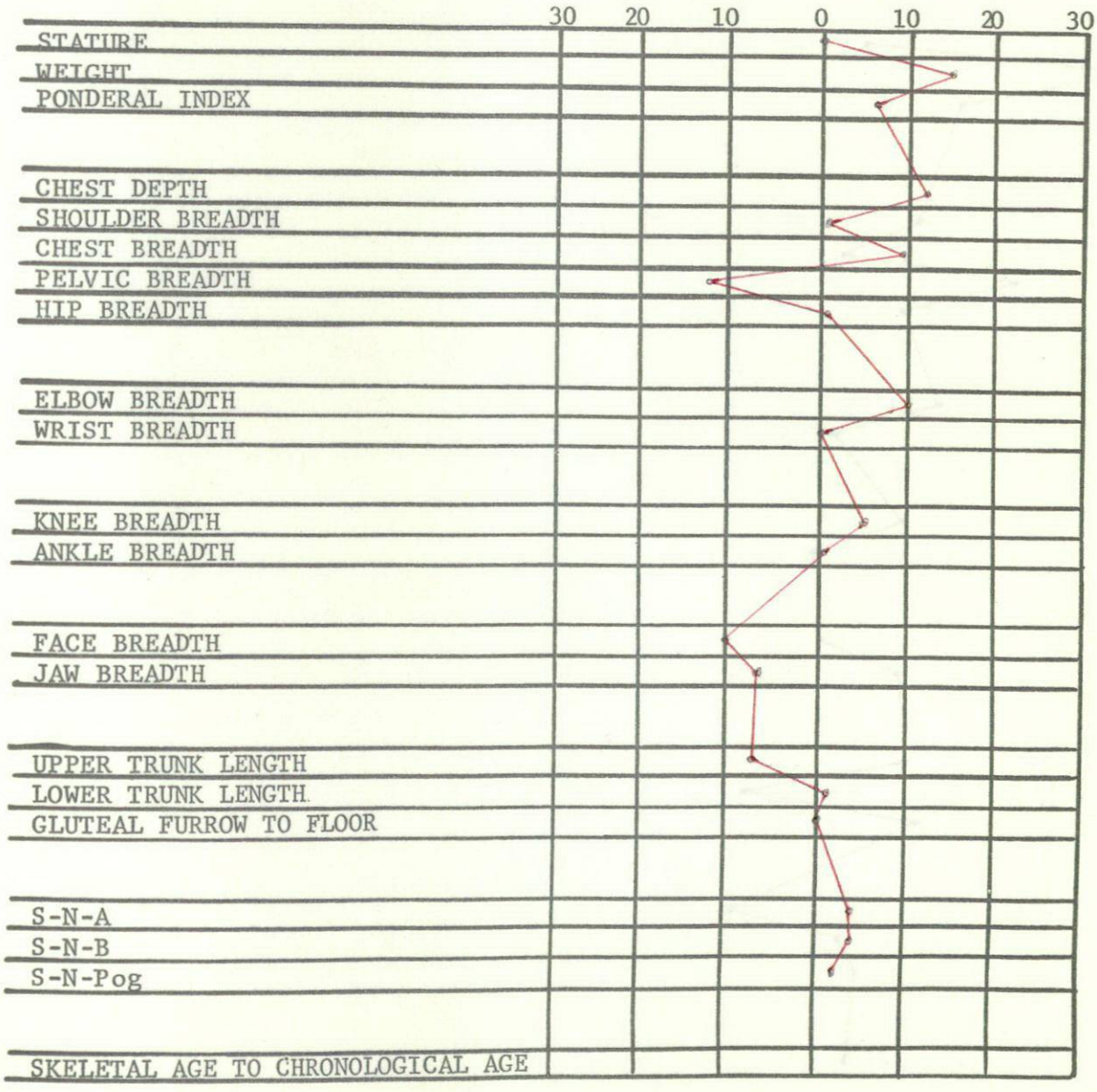


PROFILE CHART # 7

Pt. No. 4 R.L.

Male 21 years

Mandibular Prognathism 8 mm.

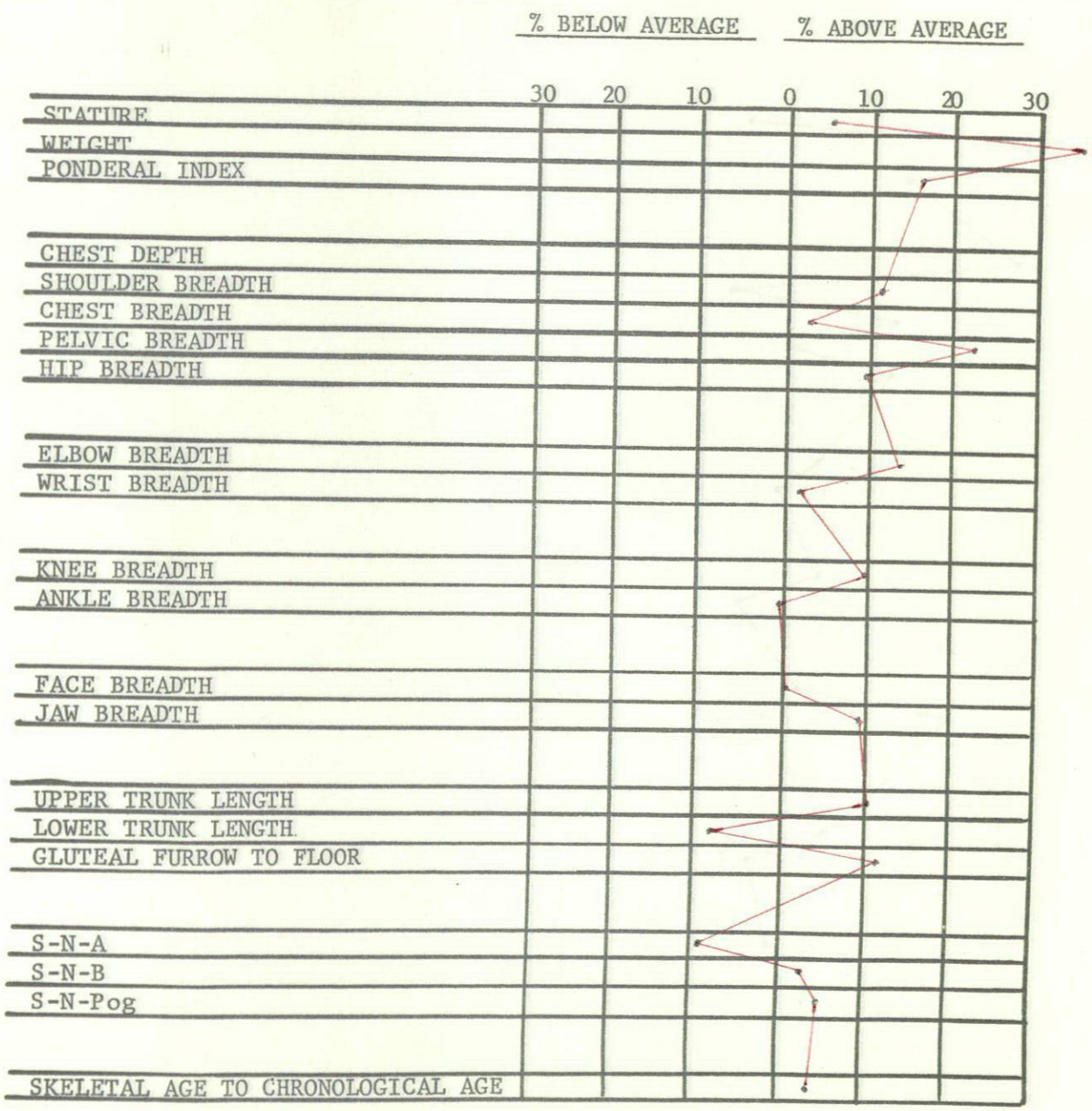


PROFILE CHART # 8

Pt. No. 5 K.C.

Female 18 years

Mandibular Prognathism 9 mm.

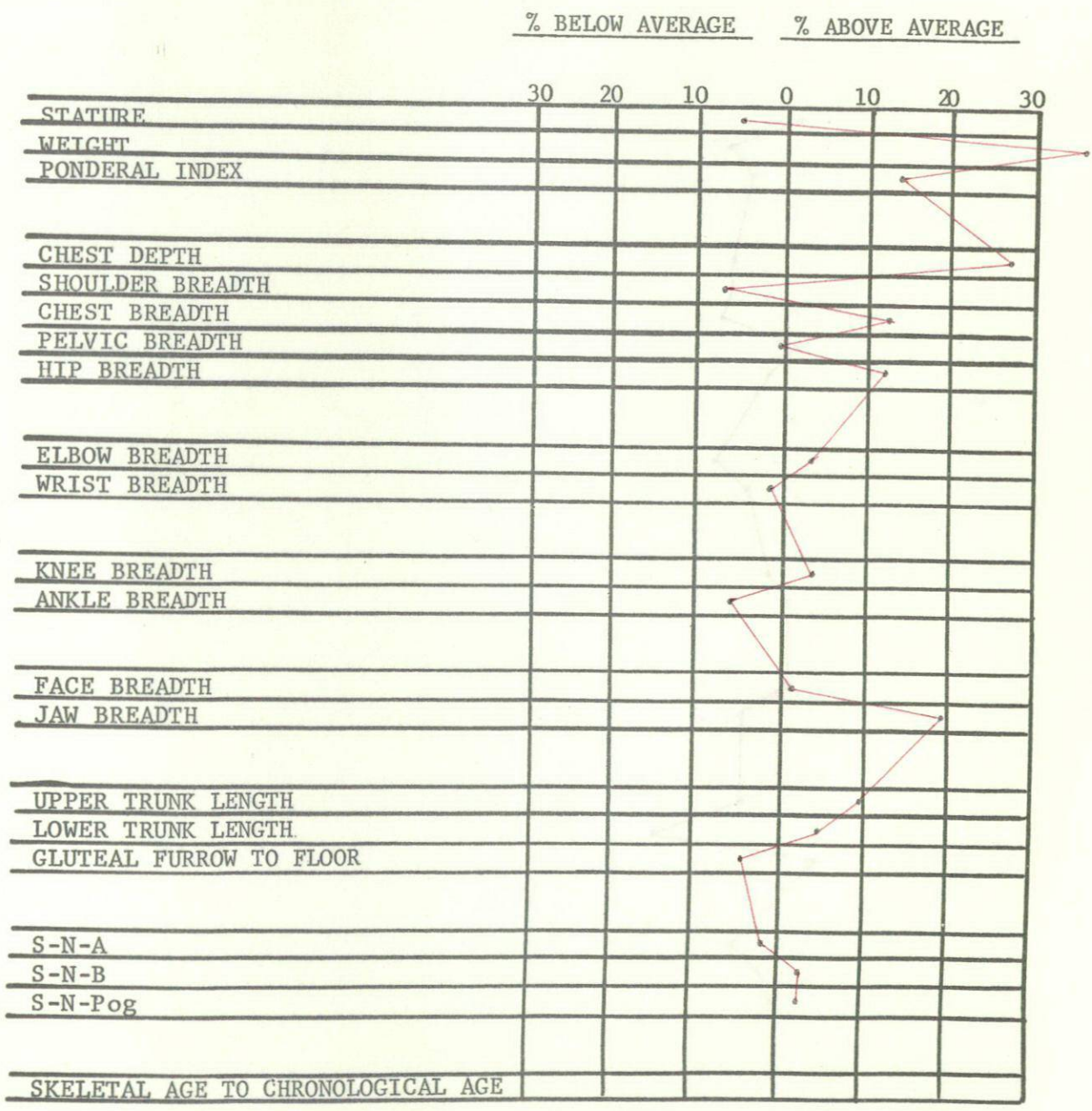


PROFILE CHART # 9

Pt. No. 6 H.G.

Female 15 years

Mandibular Prognathism

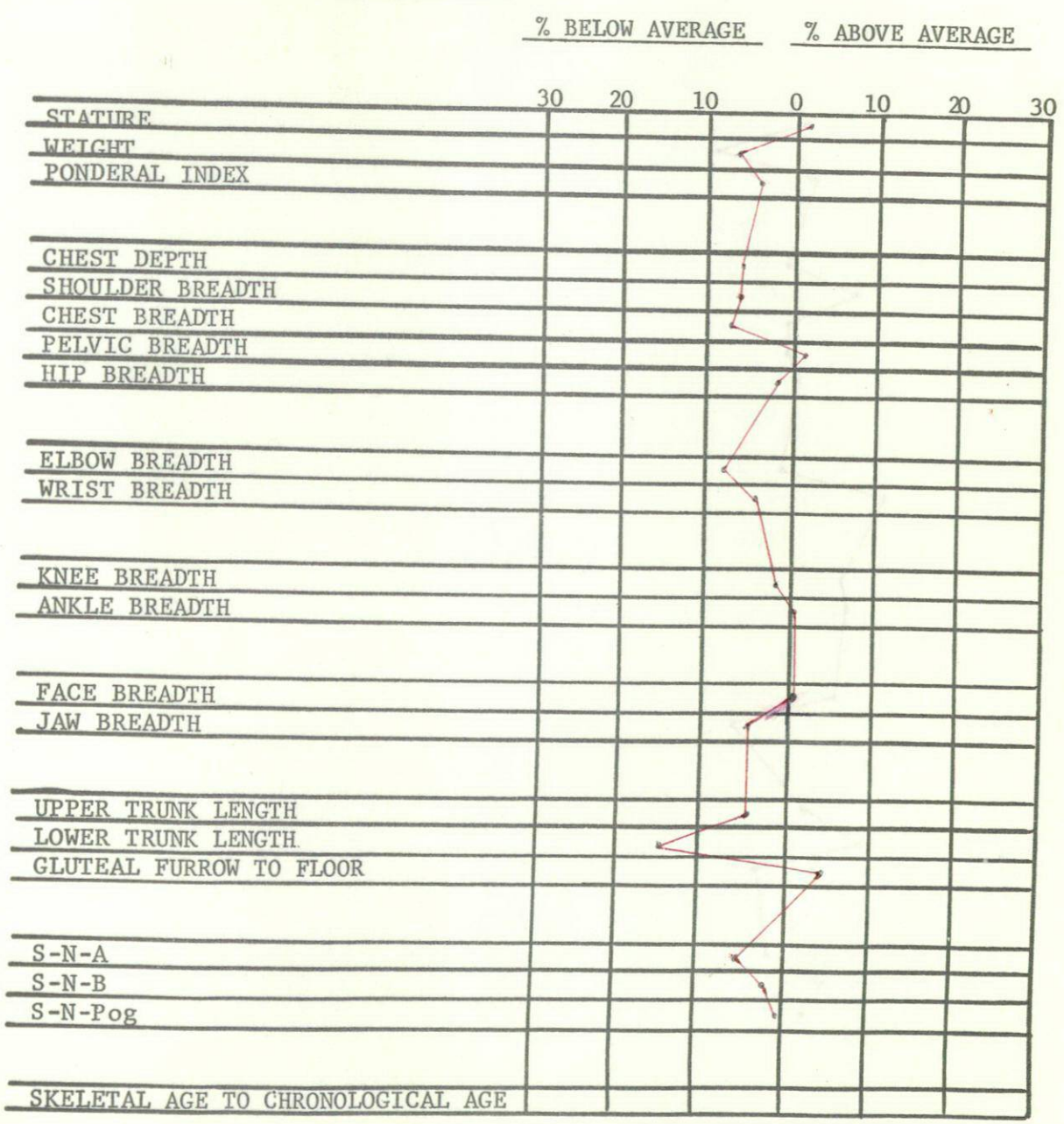


PROFILE CHART # 10

Pt. No. 7 C.P.

Female 17 years

Mandibular Prognathism 8 mm.

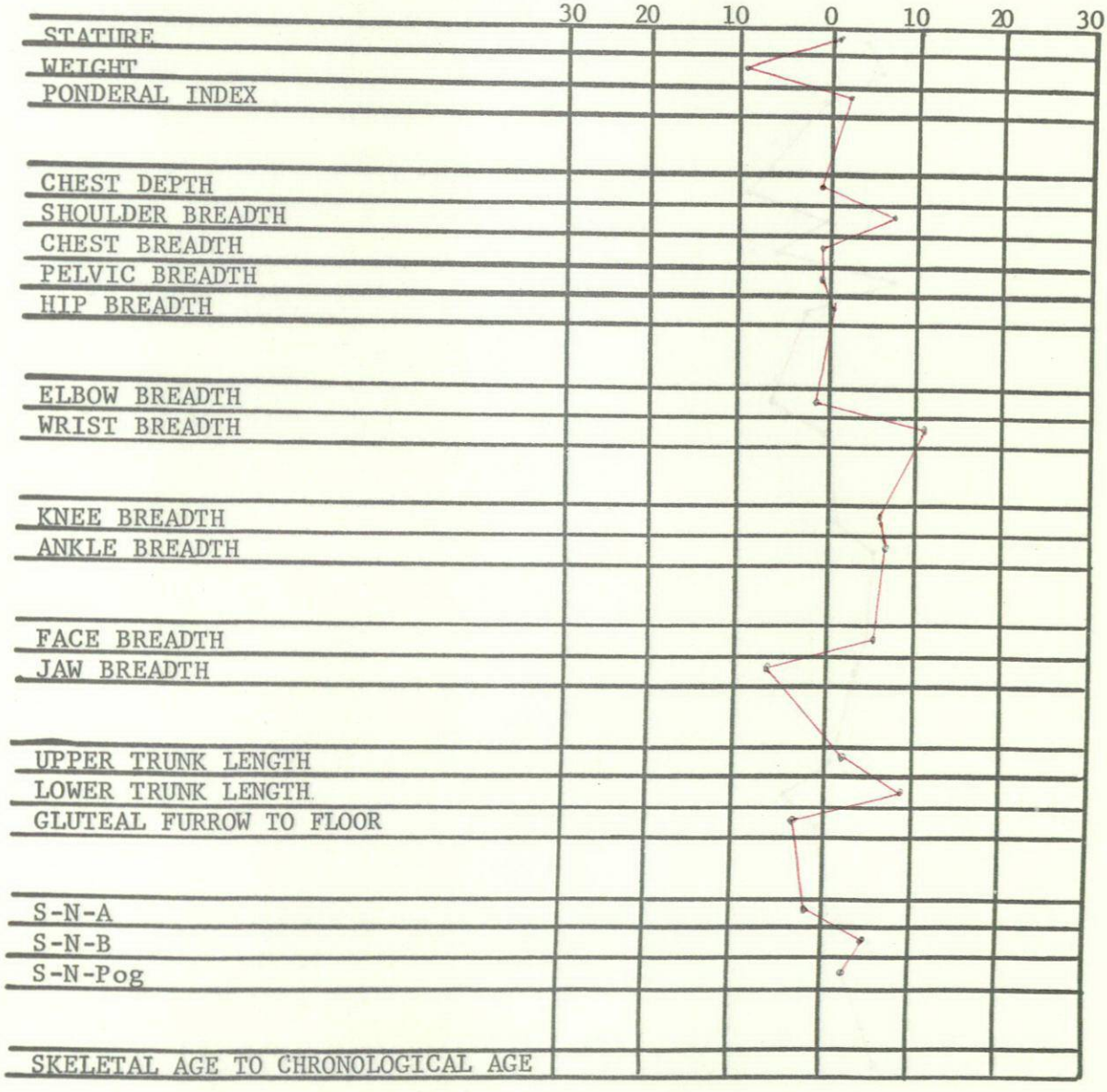


PROFILE CHART # 11

Pt. No. 8 G.H.

Female 25 years

Mandibular Prognathism 6 mm.

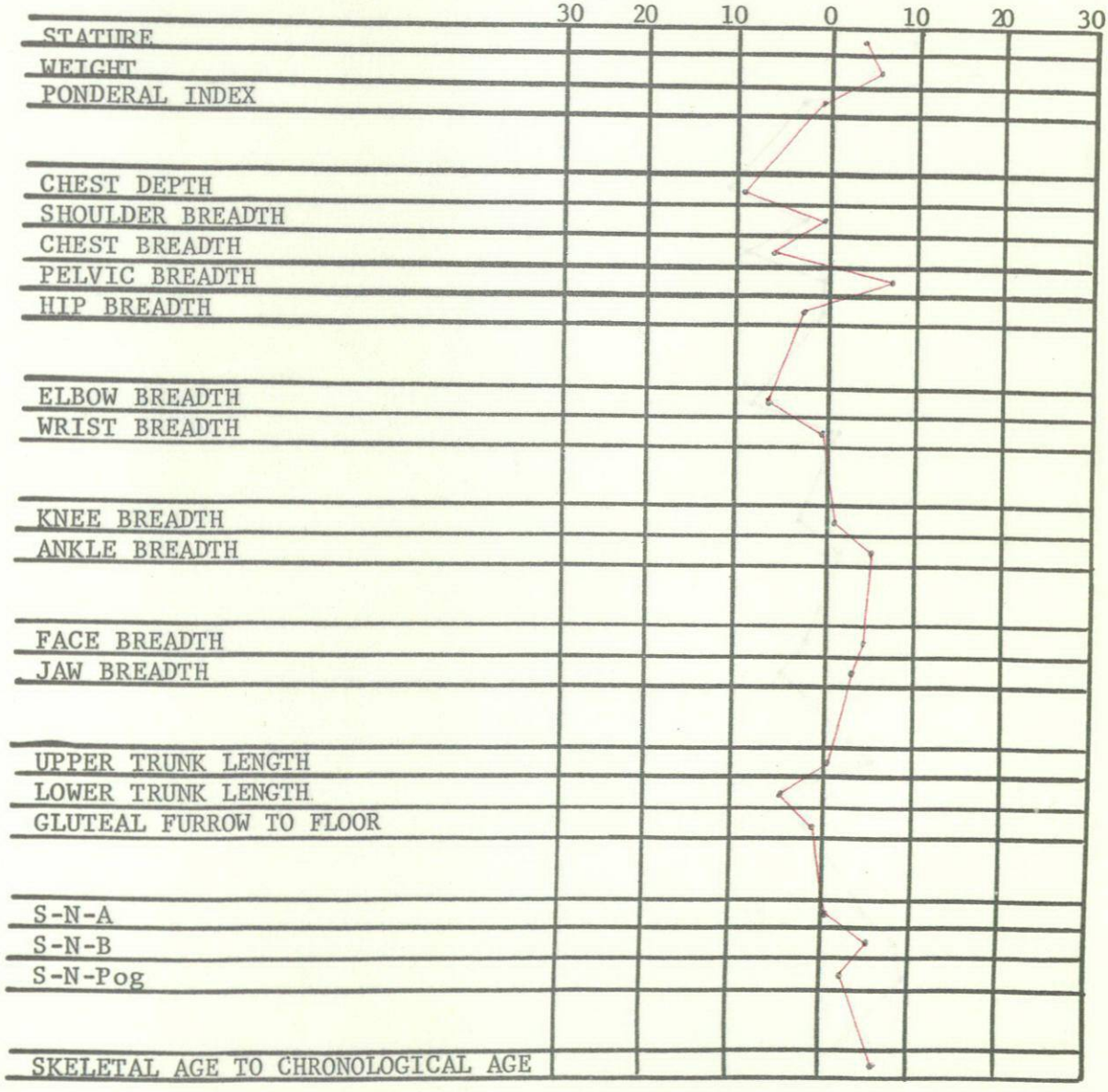


PROFILE CHART # 12

Pt. No. 9 I.Y.

Female 15 years

Mandibular Prognathism 8 mm.

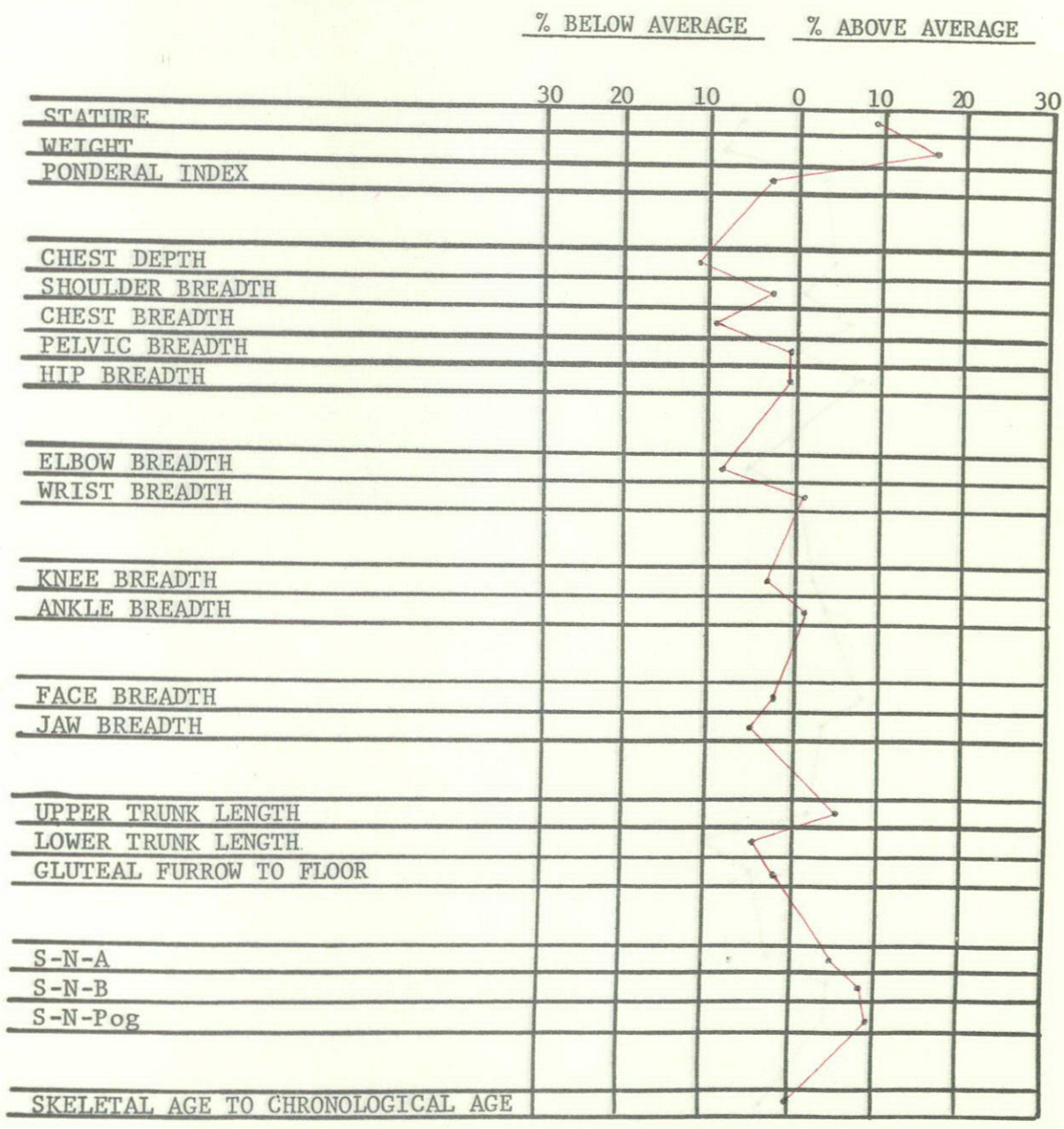


PROFILE CHART # 13

Pt. No. 10 J.R.

Male 16 yrs.

Mandibular Prognathism 5 mm.

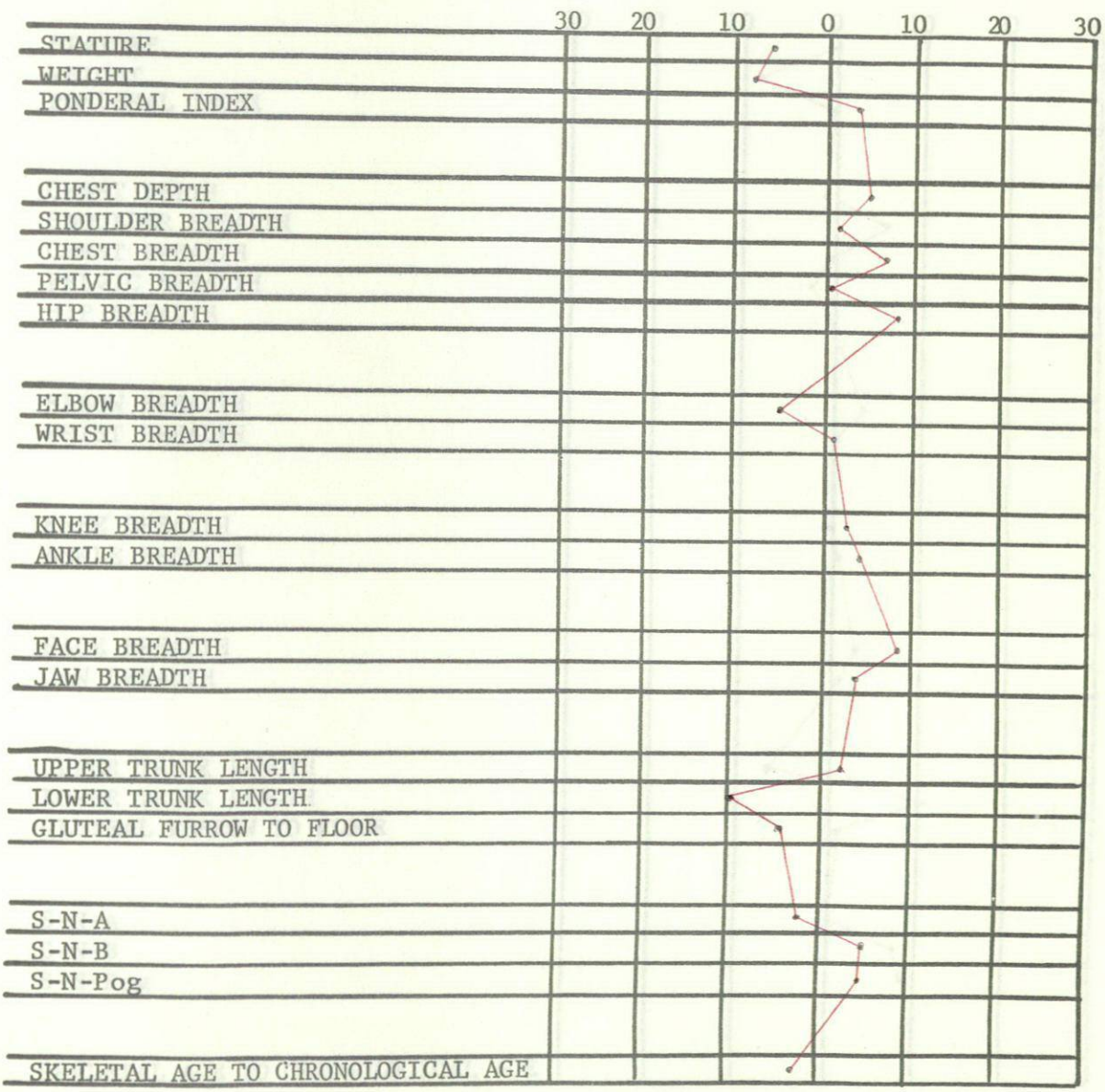


PROFILE CHART # 14

Pt. No. 11 C.J.

Female 15 years

Mandibular Prognathism 4 mm.

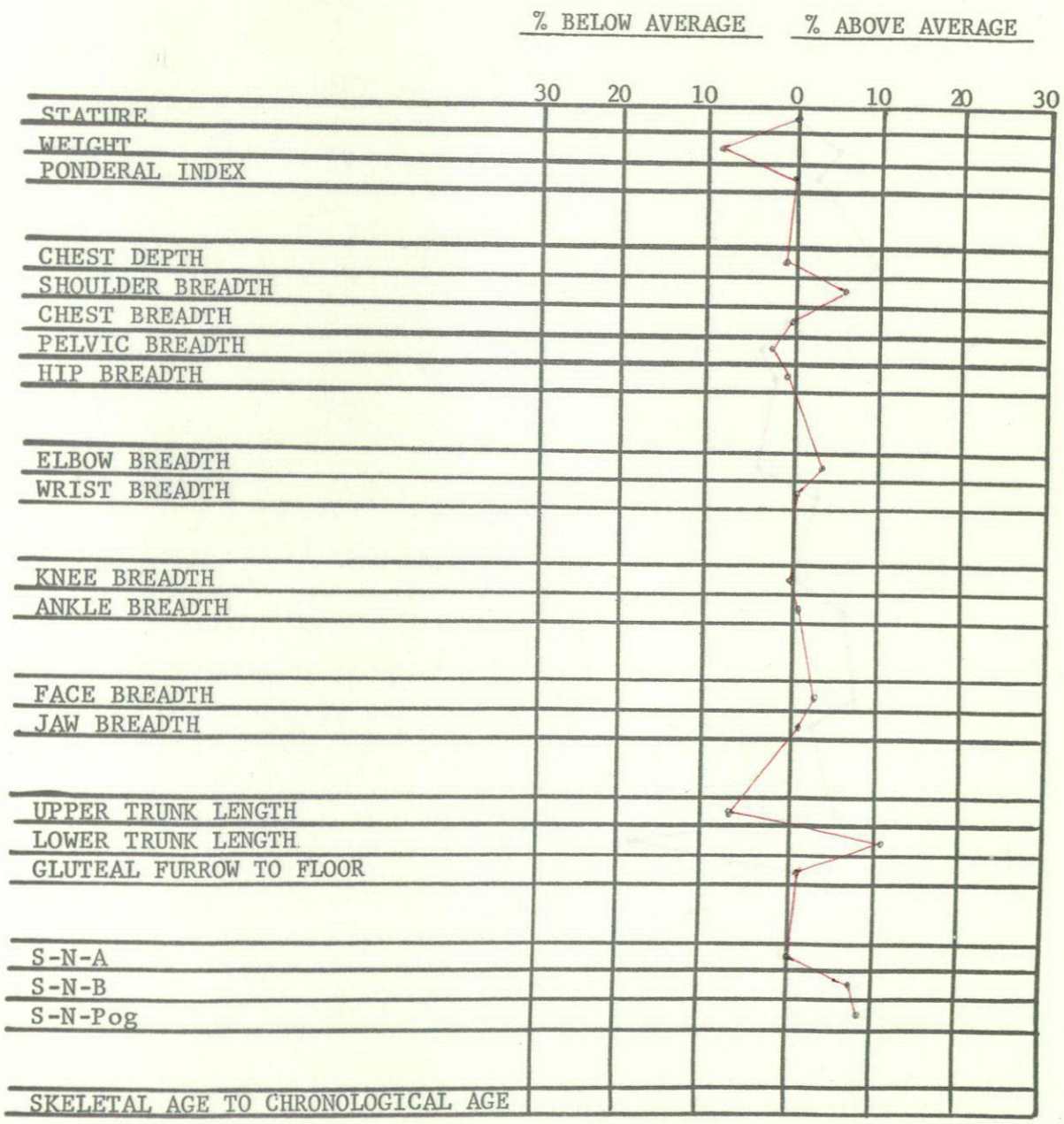


PROFILE CHART # 15

Pt. No. 12 C.S.

Male 22 years

Mandibular Prognathism 11 mm.

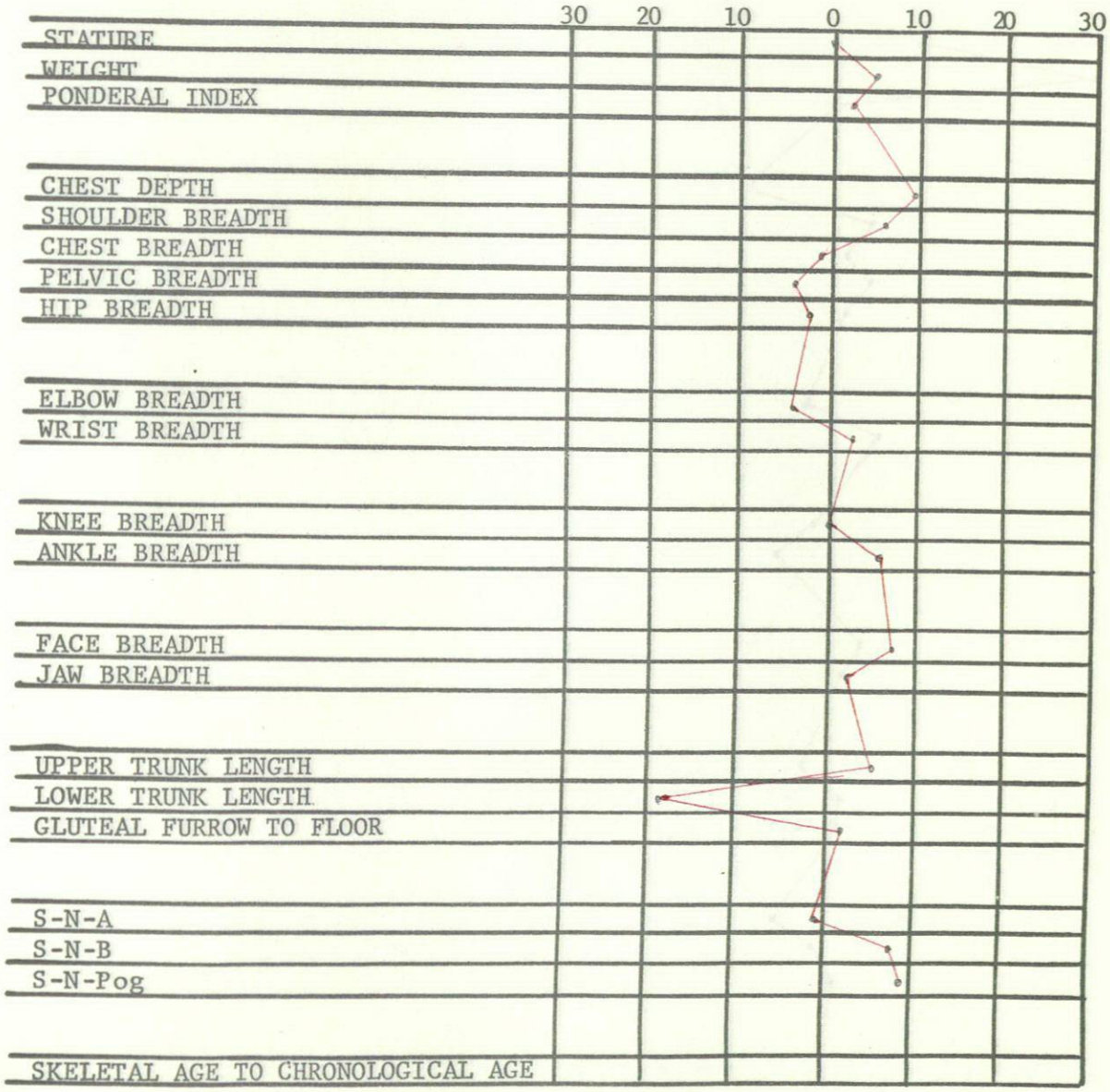


PROFILE CHART # 16

Pt. No. 13 N.D.

Female 18 years

Mandibular Prognathism 10 mm.

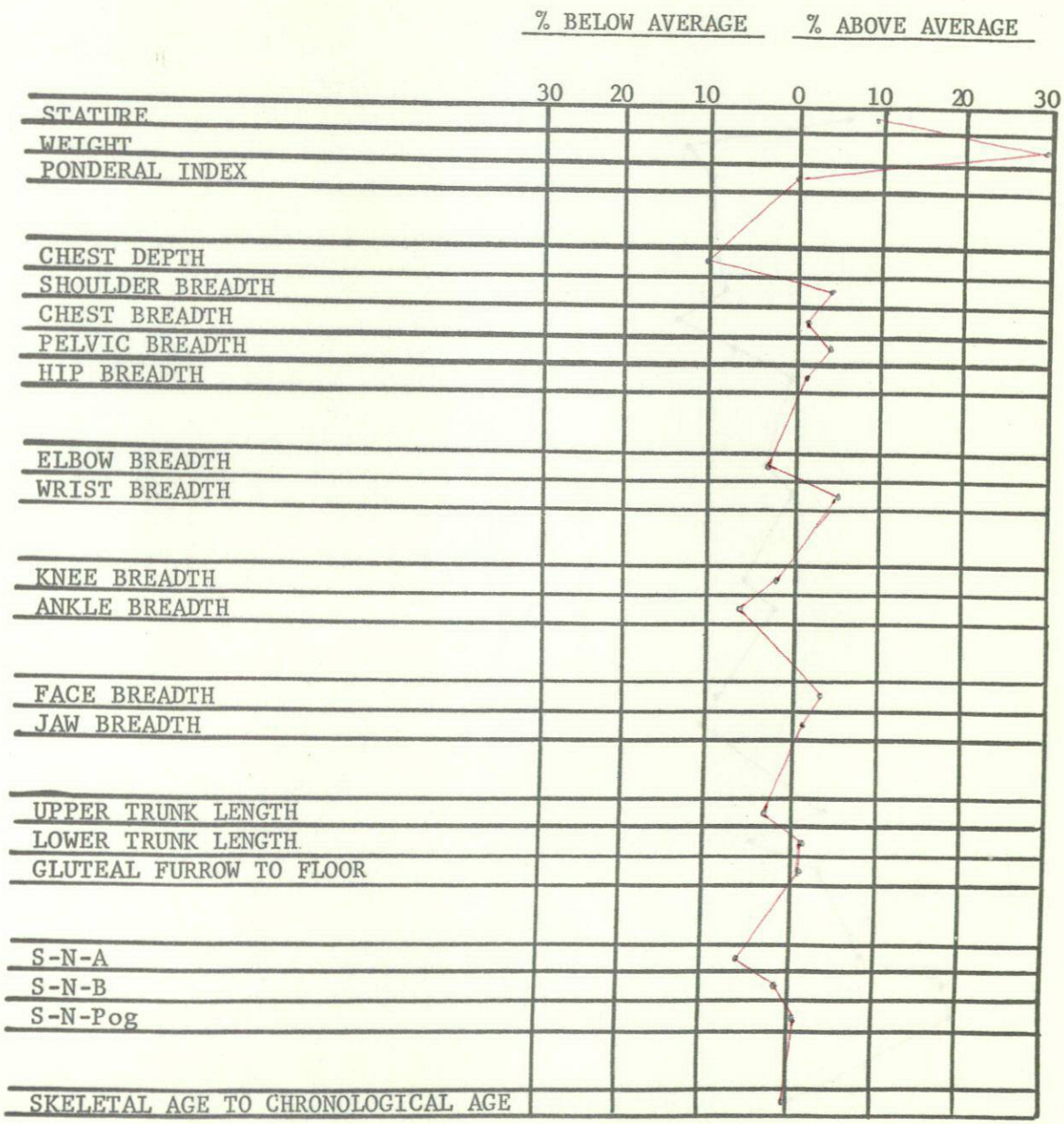


PROFILE CHART # 17

Pt. No. 14 T.C.

Male 15 years

Mandibular Prognathism 6 mm.

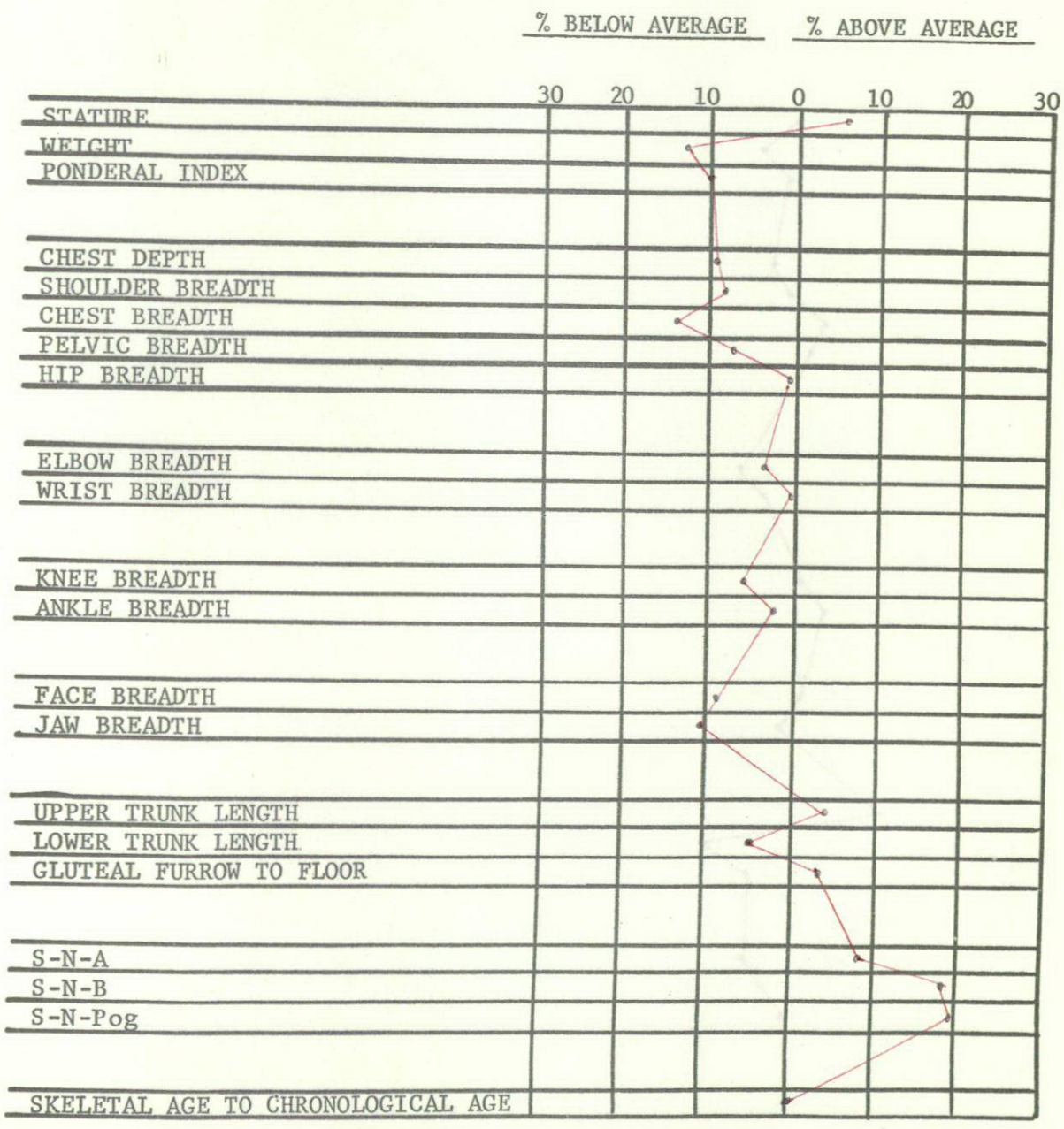


PROFILE CHART # 18

Pt. No. 15 A.S.

Male 15 years

Mandibular Prognathism 8 mm.

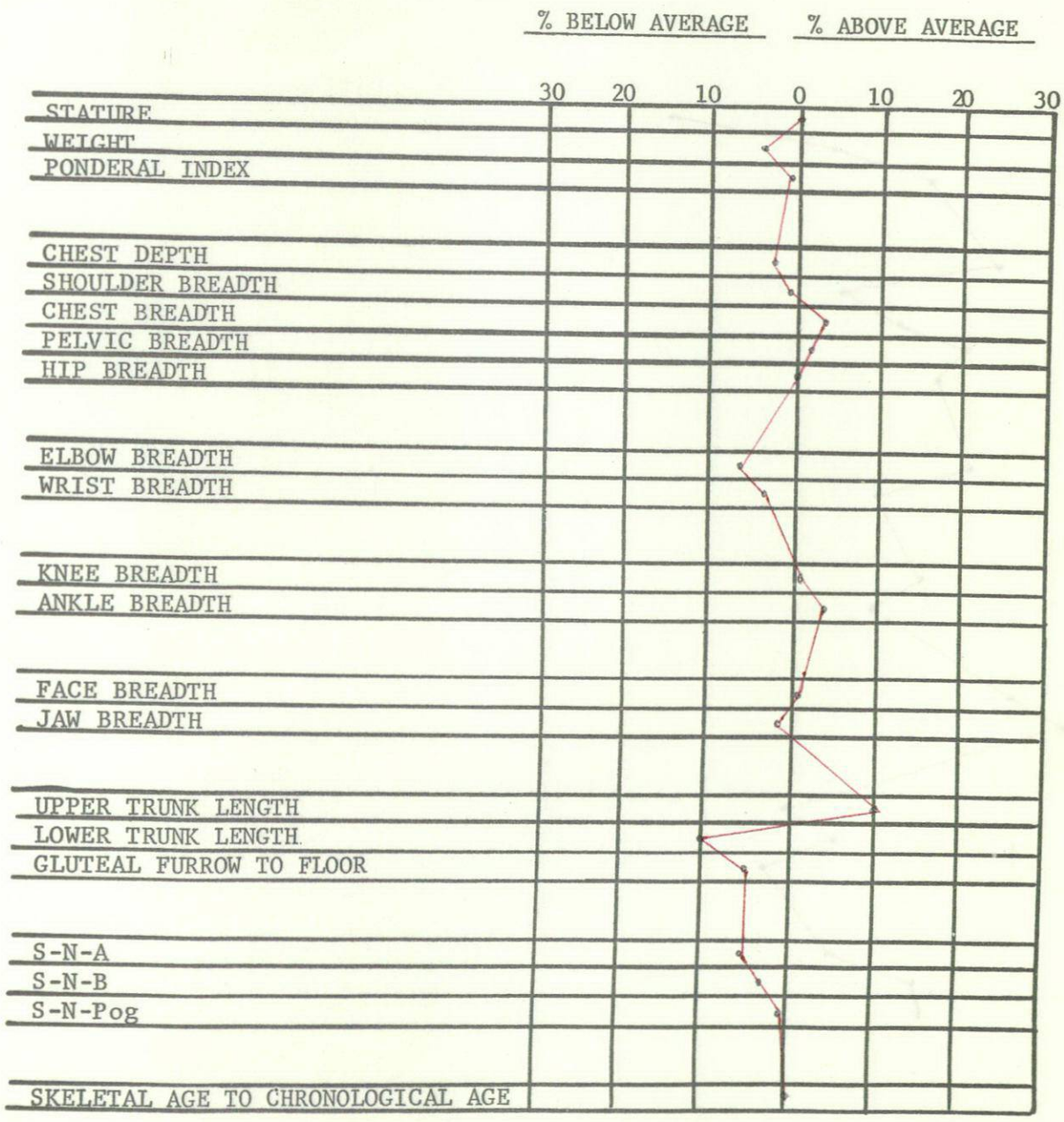


PROFILE CHART # 19

Pt. No. 16 P.M.

Female 16 years

Mandibular Prognathism 8 mm.

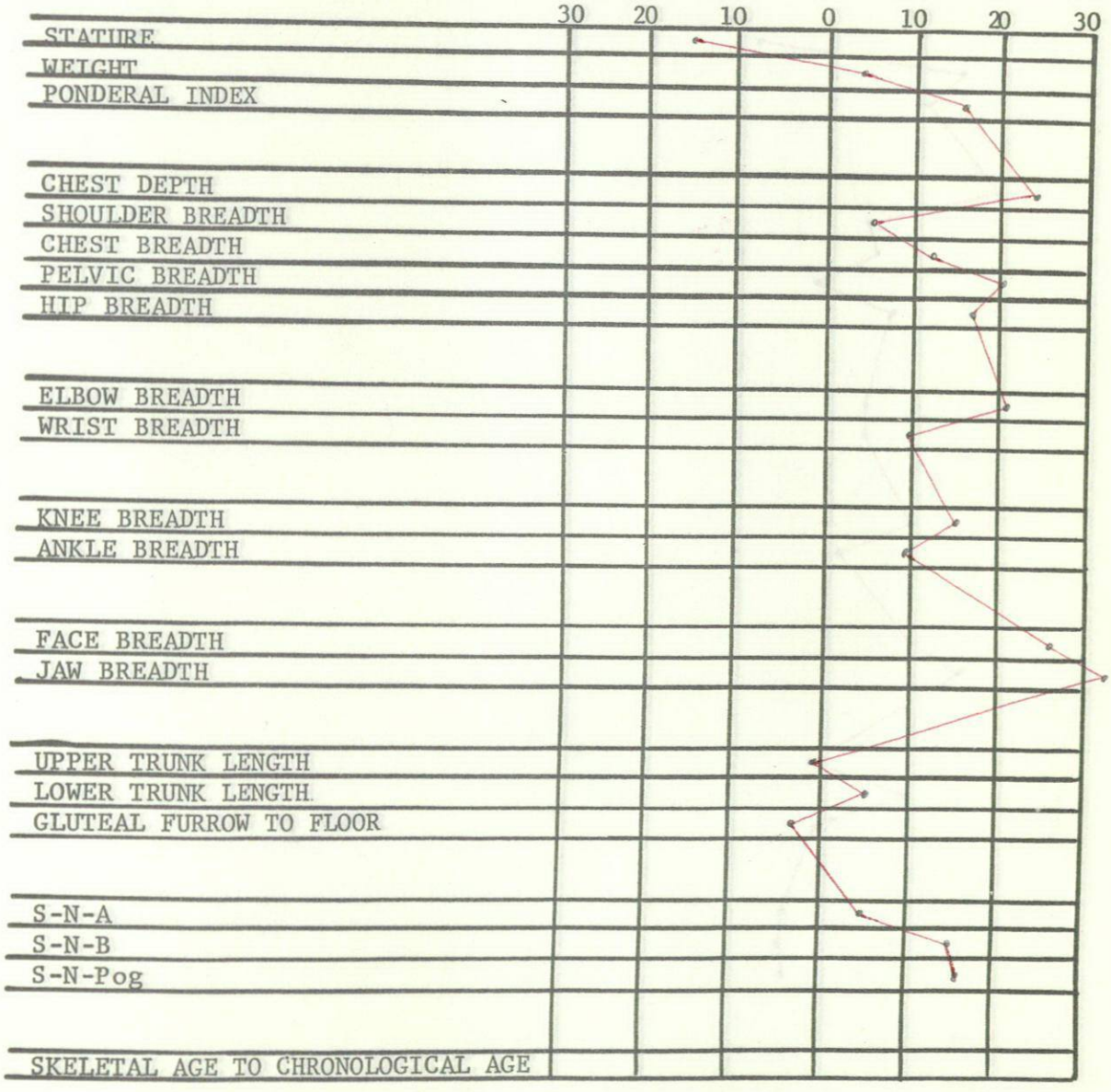


PROFILE CHART # 20

Pt. No. 17 J.P.

Male 17 years

Mandibular Prognathism 7 mm.

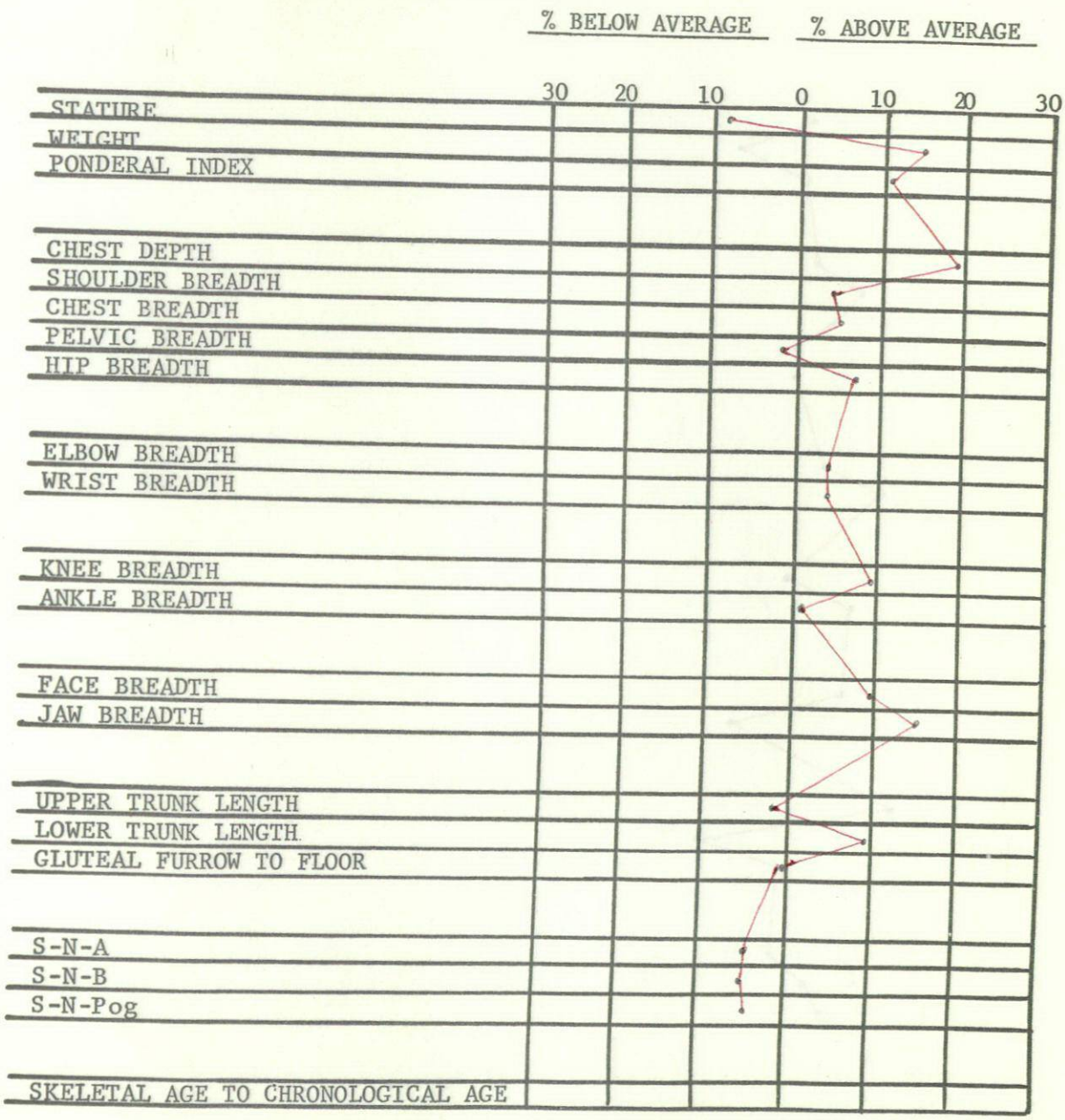


PROFILE CHART # 21

Pt. No. 18 J.H.

Male 18 years

Mandibular Prognathism 5 mm.

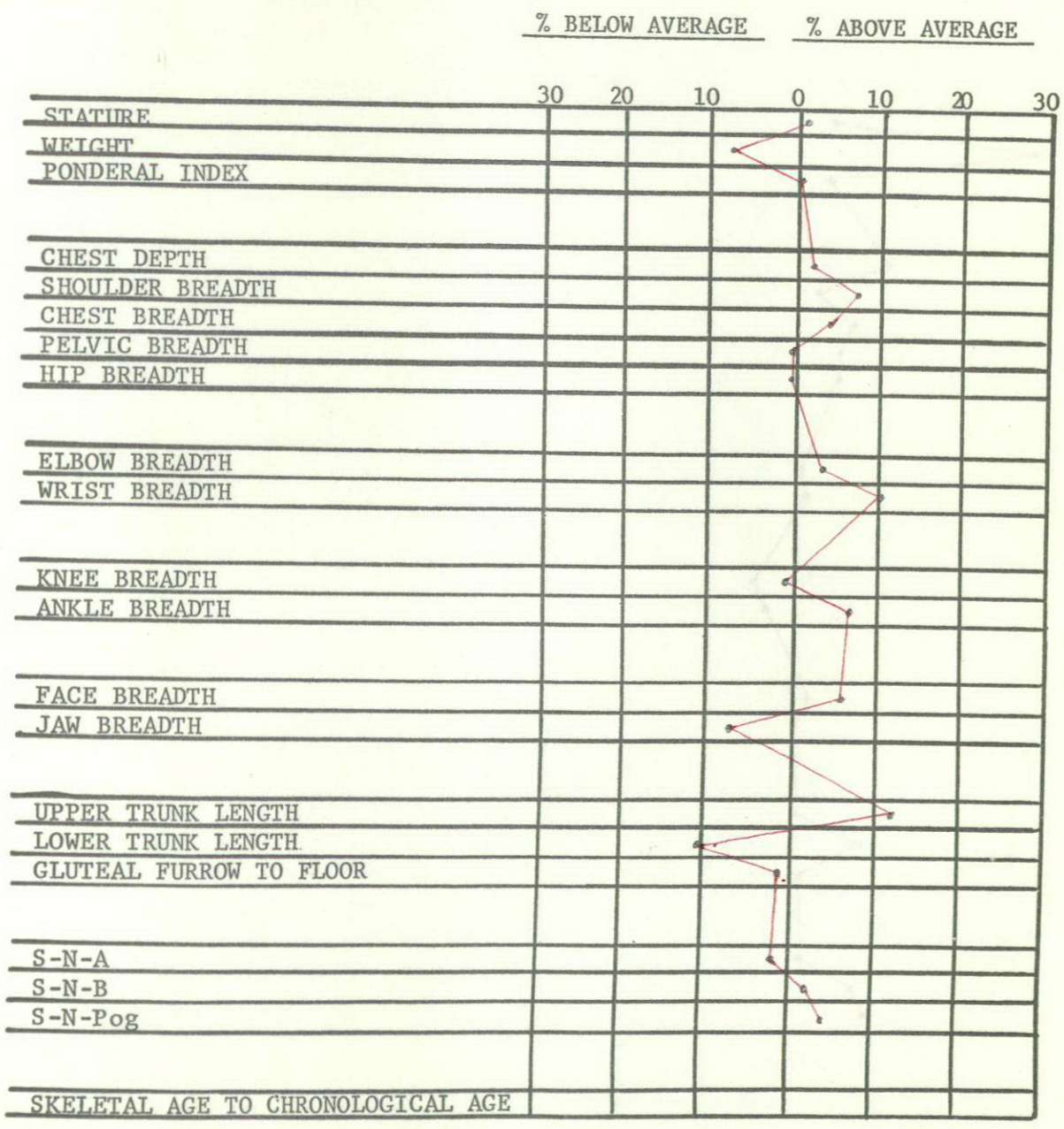


PROFILE CHART # 22

Pt. No. 19 B.T.

Female 24 years

Mandibular Prognathism 8 mm.

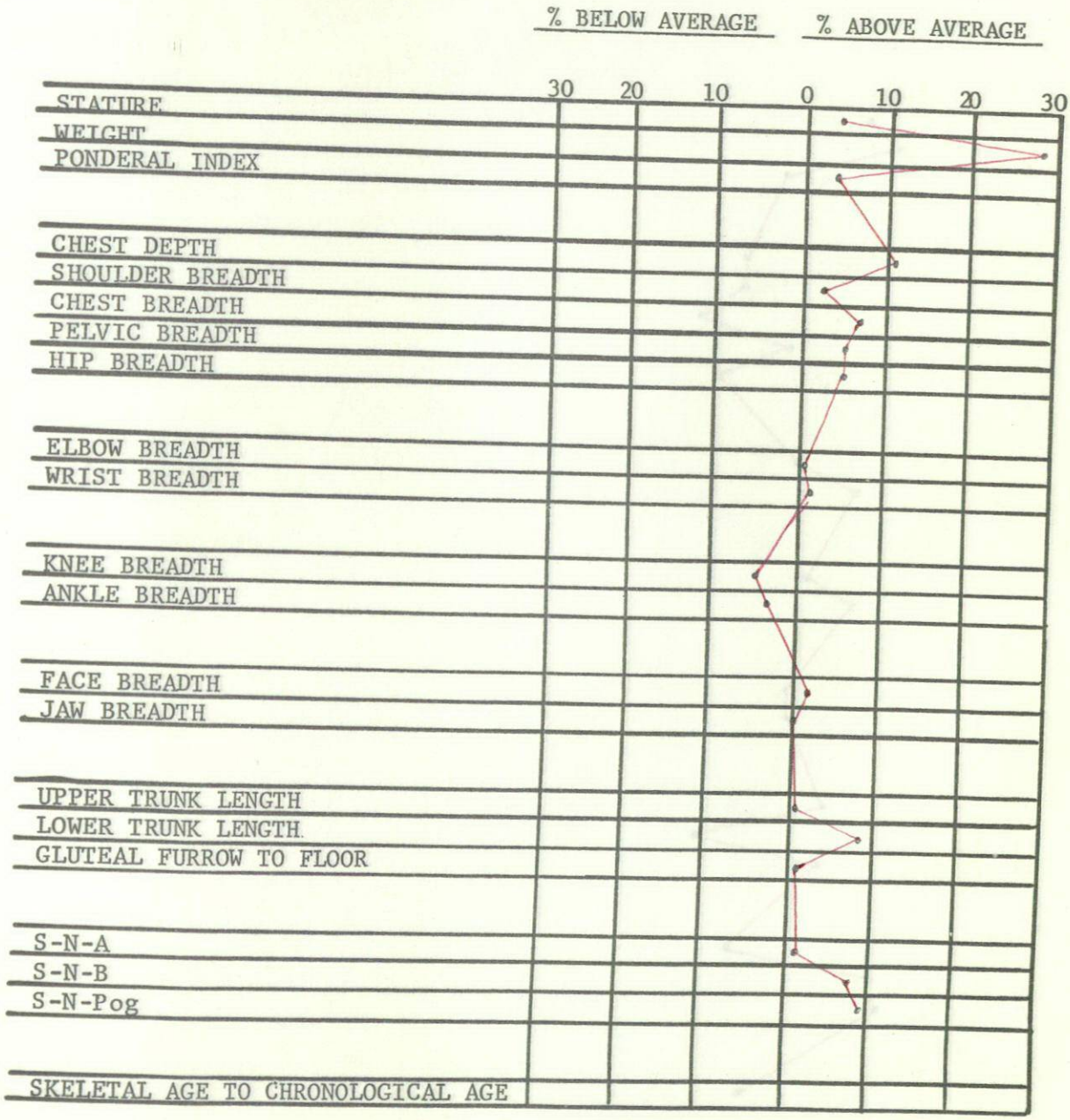


PROFILE CHART # 23

Pt. No. 20 W.H.

Male 26 years

Mandibular Prognathism 6 mm.

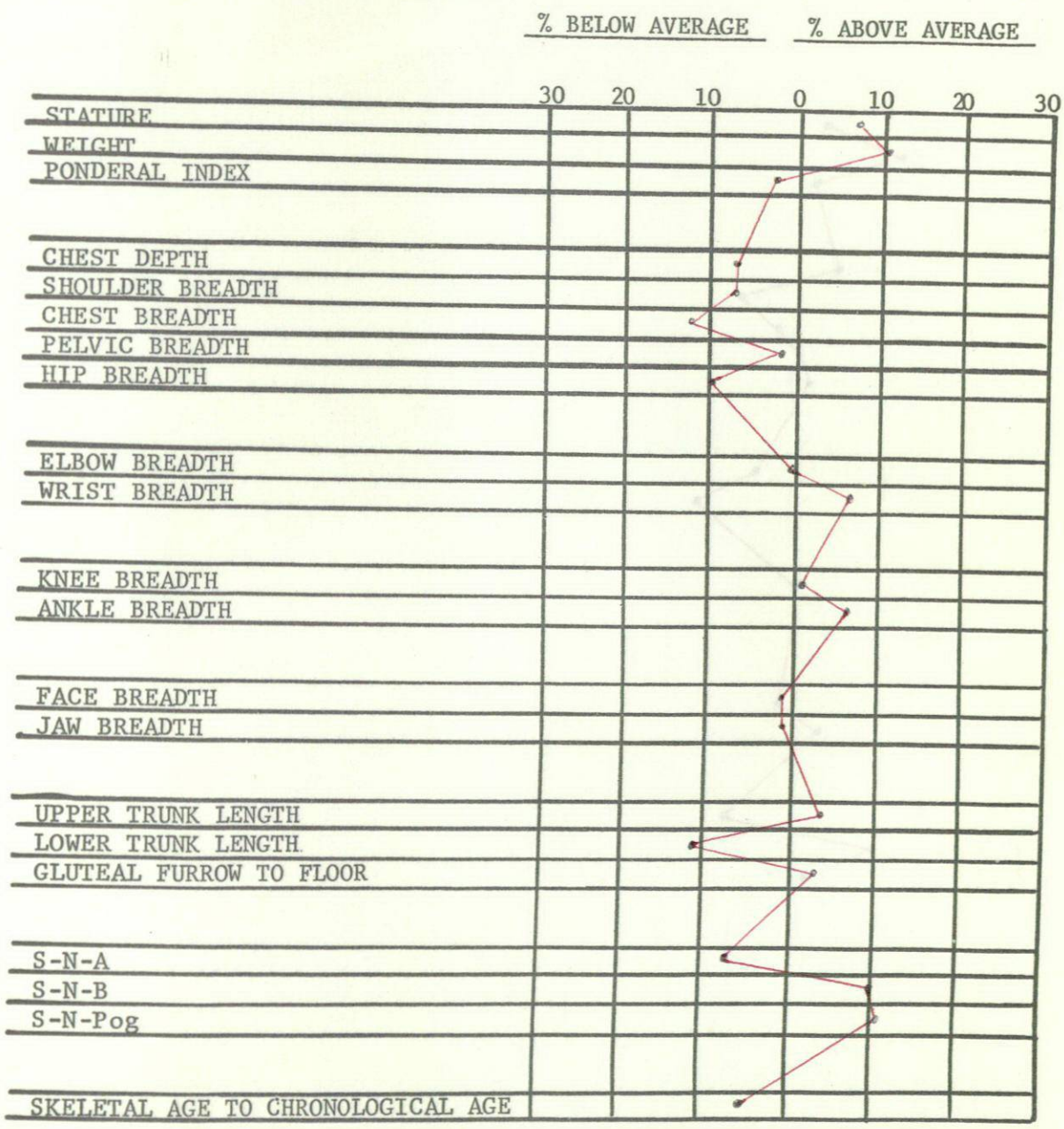


PROFILE CHART # 24

Pt. No. 21 T.S.

Female 15 years

Mandibular Prognathism 15 mm.

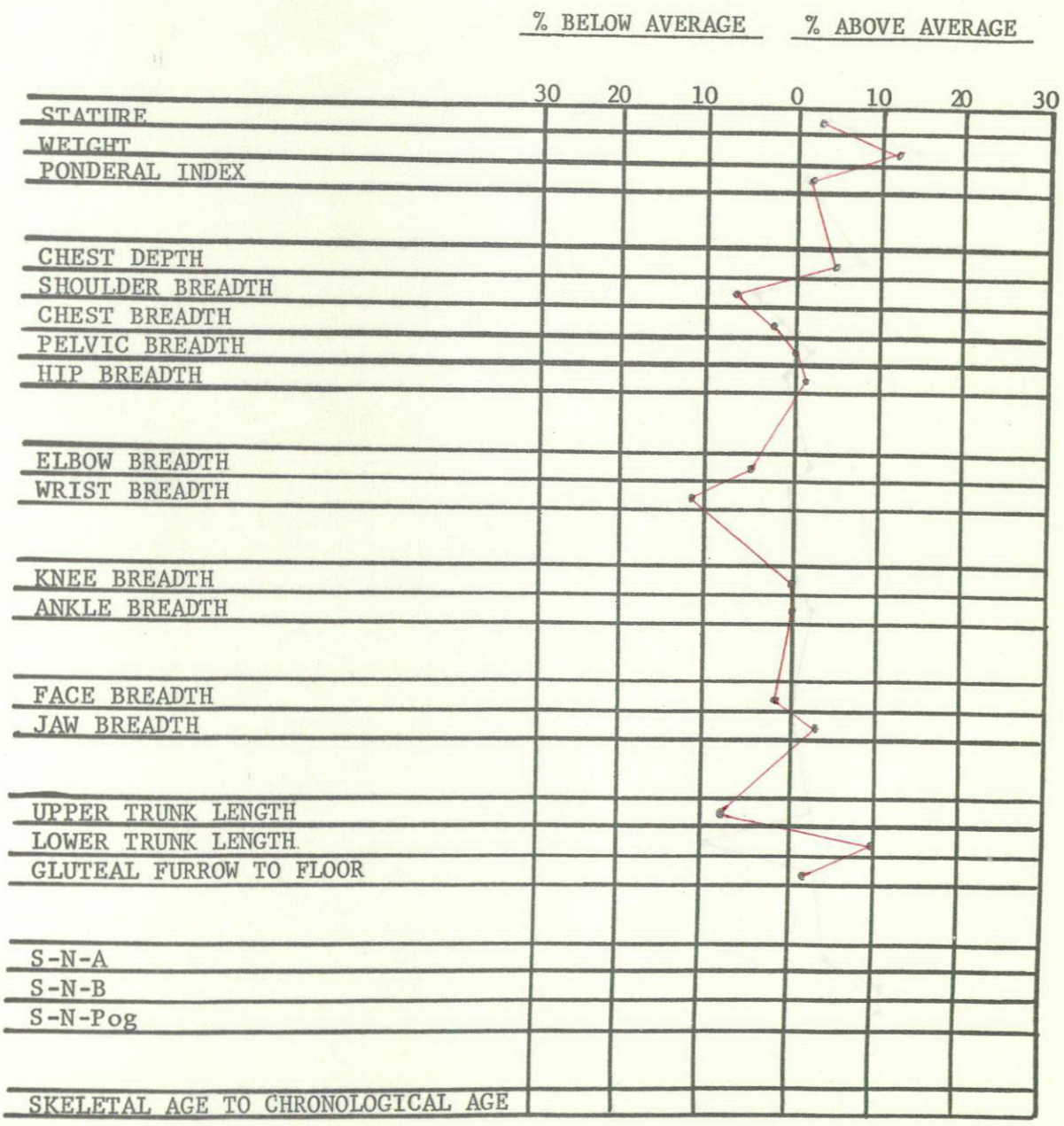


PROFILE CHART # 25

Pt. No. 22 L.K.

Female 17 years

Mandibular Prognathism 8 mm.

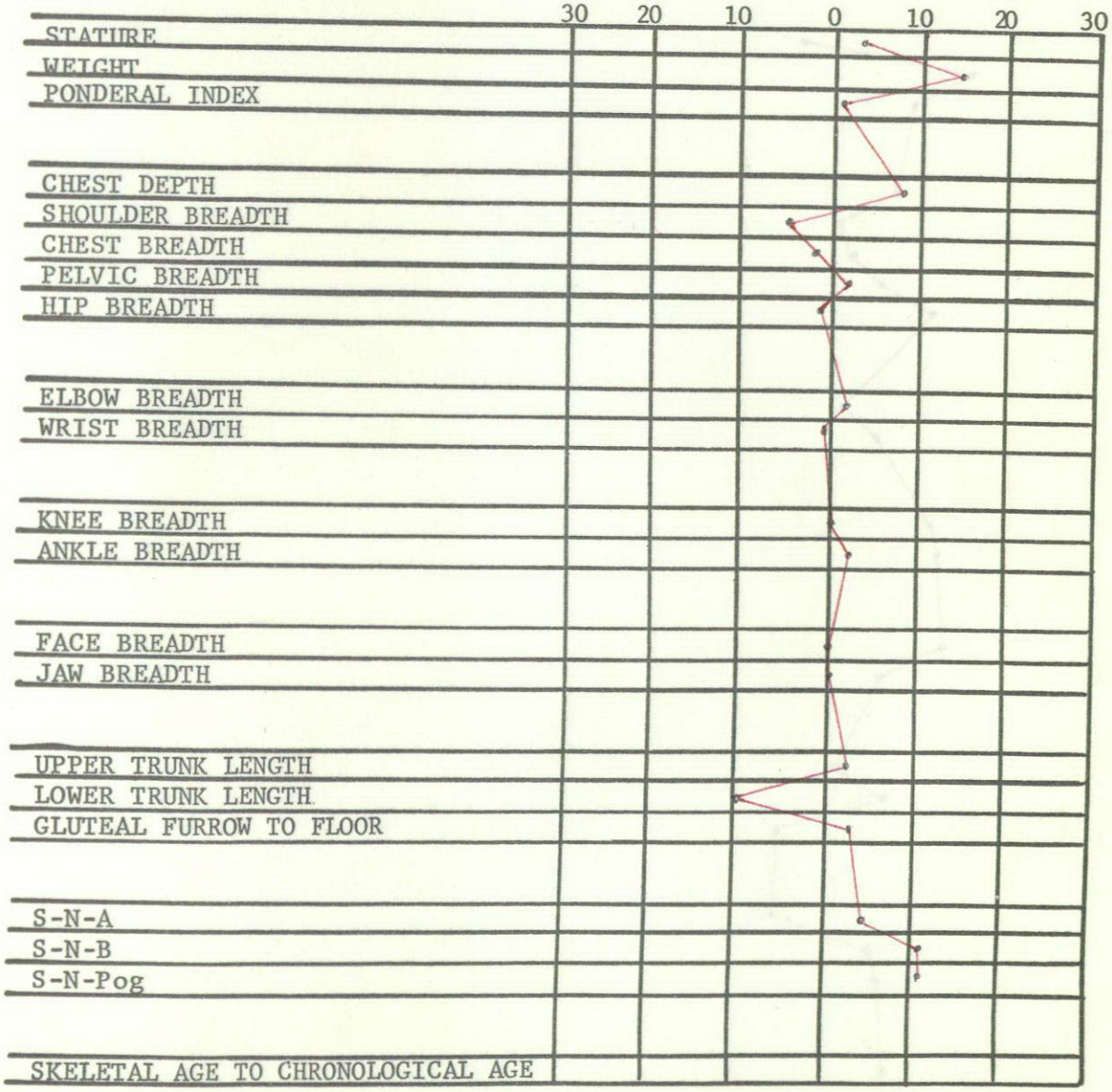


PROFILE CHART # 26

Pt. No. 23 C.S.

Male 34 years

Mandibular Prognathism 12 mm.

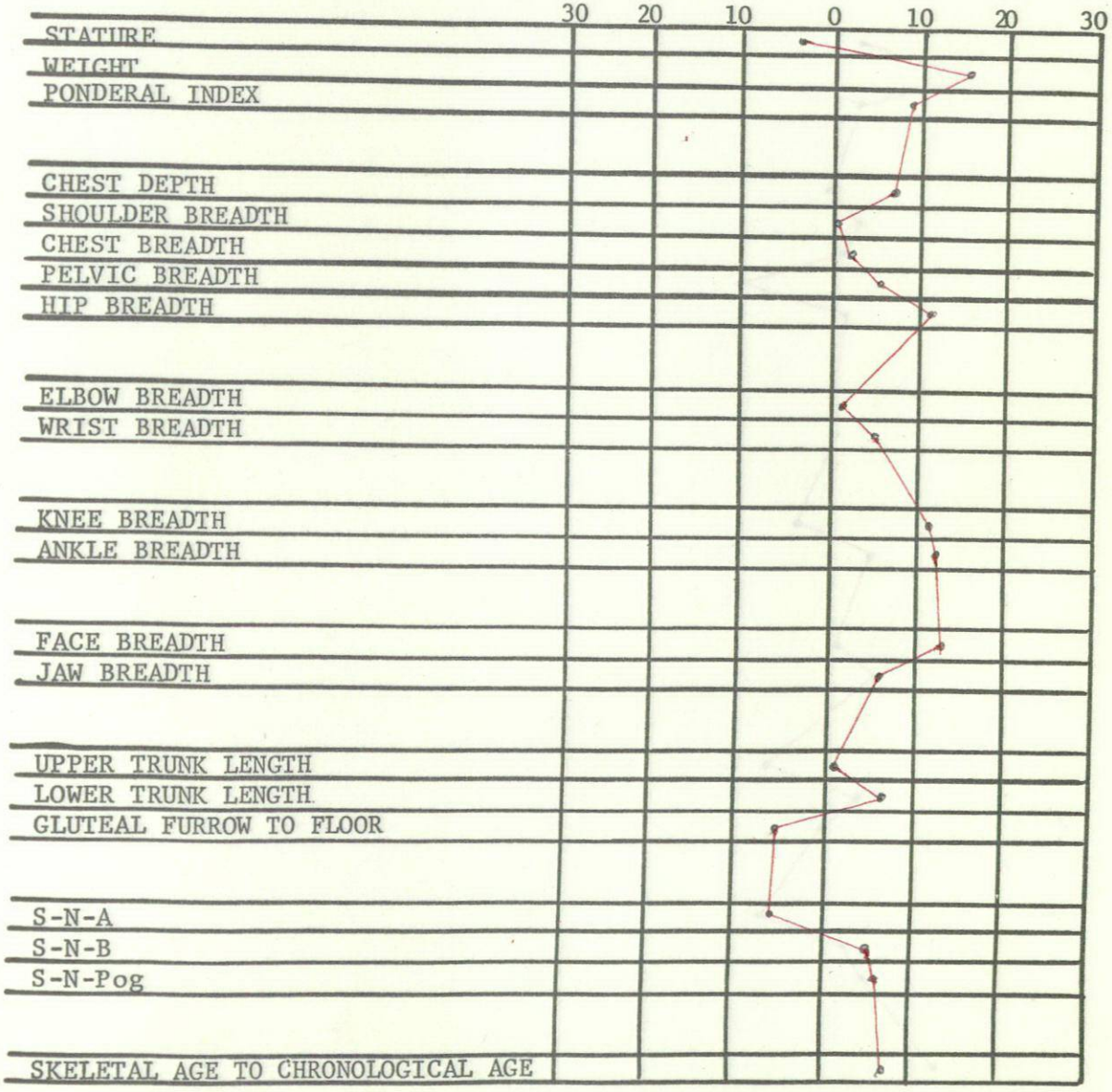


PROFILE CHART # 27

Pt. No. 24 J.D.

Female 15 years

Mandibular Prognathism 7 mm.

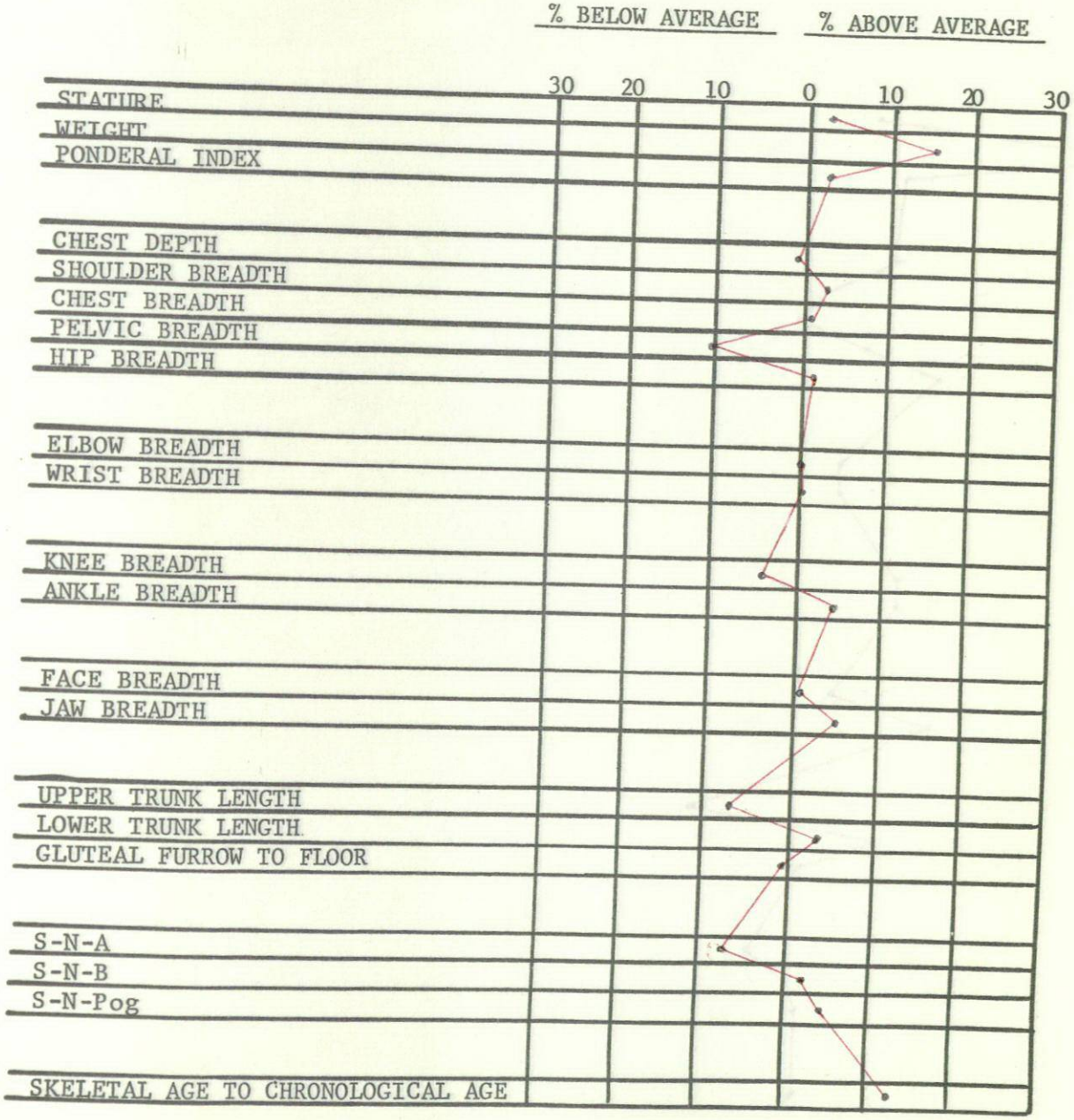


PROFILE CHART # 28

Pt. No. 25 S.S.

Female 13 years

Mandibular Prognathism 7 mm.

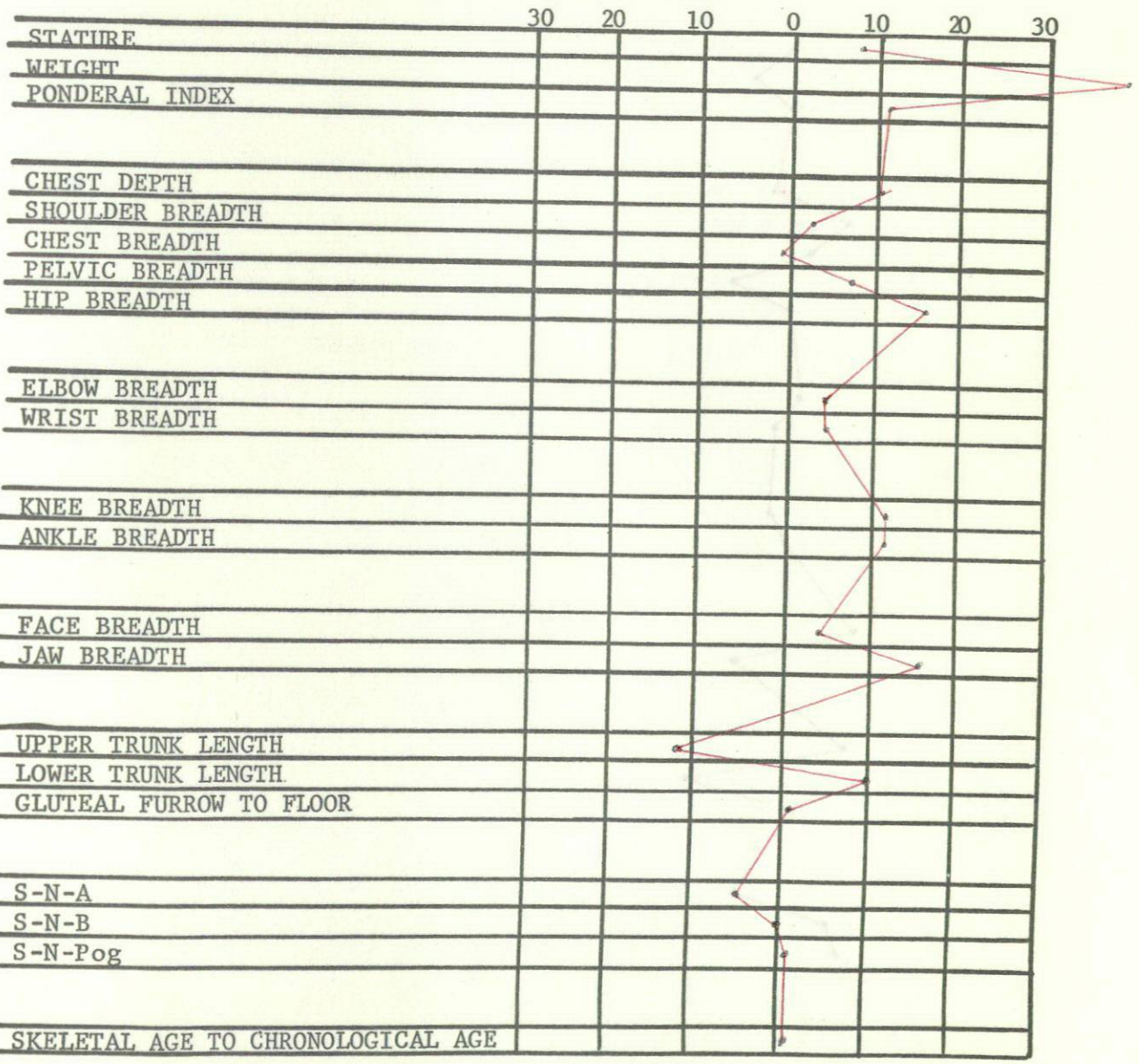


PROFILE CHART # 29

Pt. No. 26 E.T.

Male 13 years

Mandibular Prognathism 6 mm.

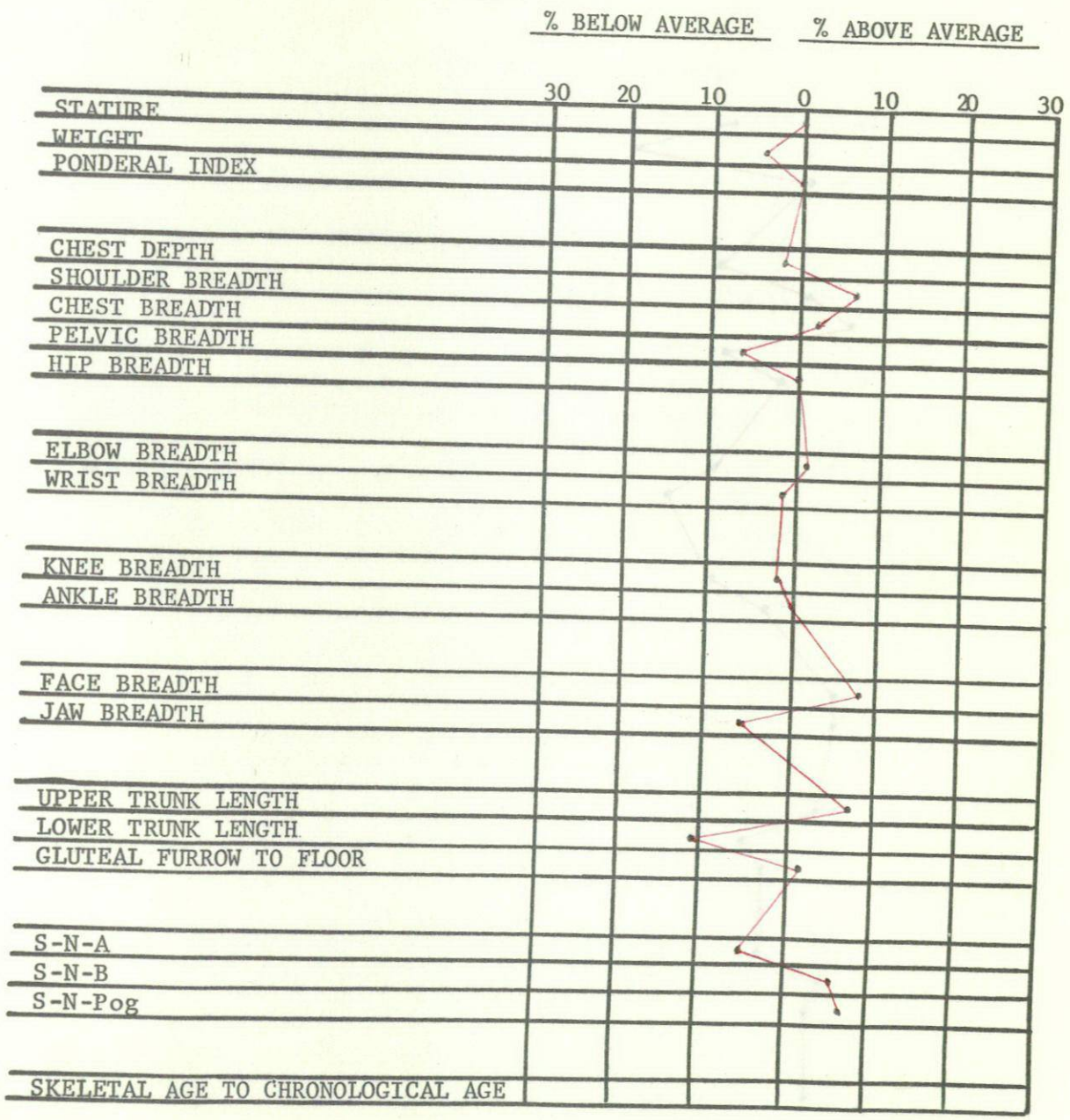


PROFILE CHART # 30

Pt. No. 27 N.M.

Female 21 years

Mandibular Prognathism 8 mm.

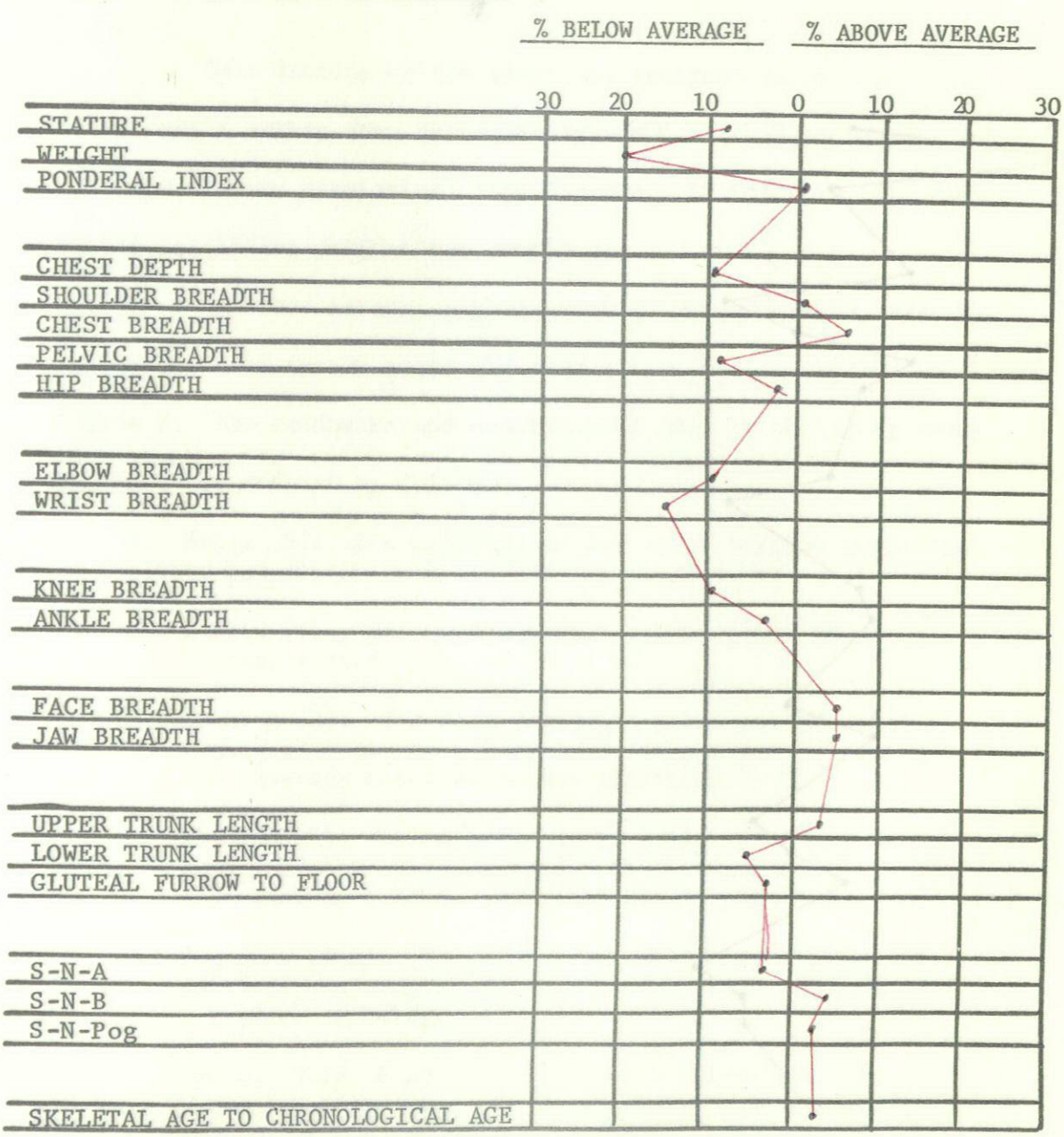


PROFILE CHART # 31

Pt. No. 28 K.B.

Female 14 years

Mandibular Prognathism 8 mm.

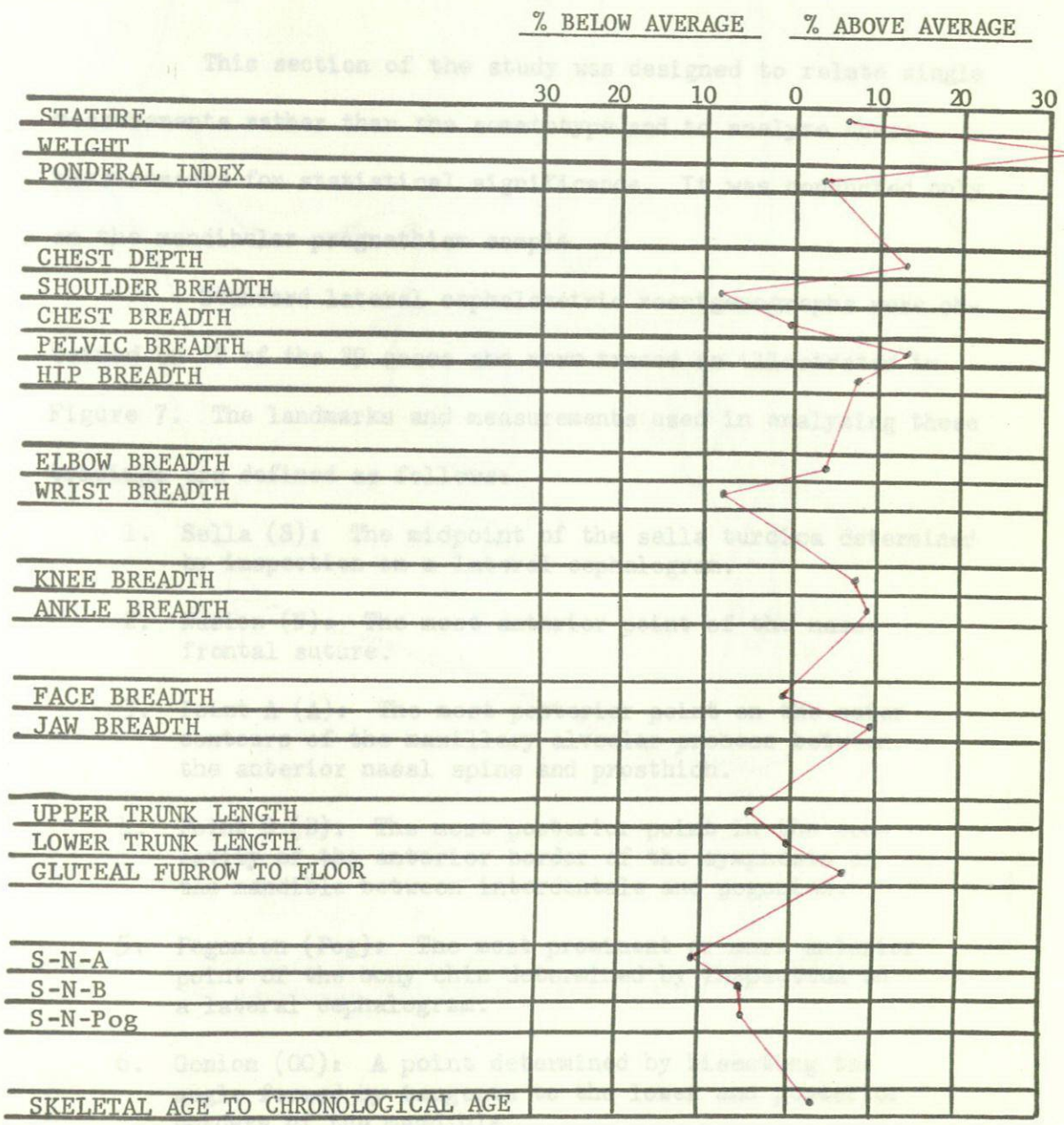


PROFILE CHART # 32

Pt. No. 29 P.P.

Male 16 years

Mandibular Prognathism 8 mm.



SECTION NO. II: STATISTICAL ANALYSIS OF SELECTED MEASUREMENTS

Methods and Materials

This section of the study was designed to relate single measurements rather than the somatotype and to analyze these measurements for statistical significance. It was conducted only on the mandibular prognathism sample.

Standard lateral cephalometric roentgenographs were obtained on 28 of the 29 cases and were traced as illustrated in Figure 7. The landmarks and measurements used in analyzing these tracings are defined as follows:

1. Sella (S): The midpoint of the sella turcica determined by inspection on a lateral cephalogram.

2. Nasion (N): The most anterior point of the naso-frontal suture.

3. Point A (A): The most posterior point on the outer contours of the maxillary alveolar process between the anterior nasal spine and prosthion.

4. Point B (B): The most posterior point in the concavity of the anterior border of the symphesis of the mandible between interdentale and pogonion.

5. Pogonion (Pog): The most prominent or most anterior point of the bony chin determined by inspection on a lateral cephalogram.

6. Gonion (GO): A point determined by bisecting the angle formed by tangents to the lower and posterior borders of the mandible.

7. Articulare (Ar): A point at the contour of the external cranial base and the dorsal contour of the

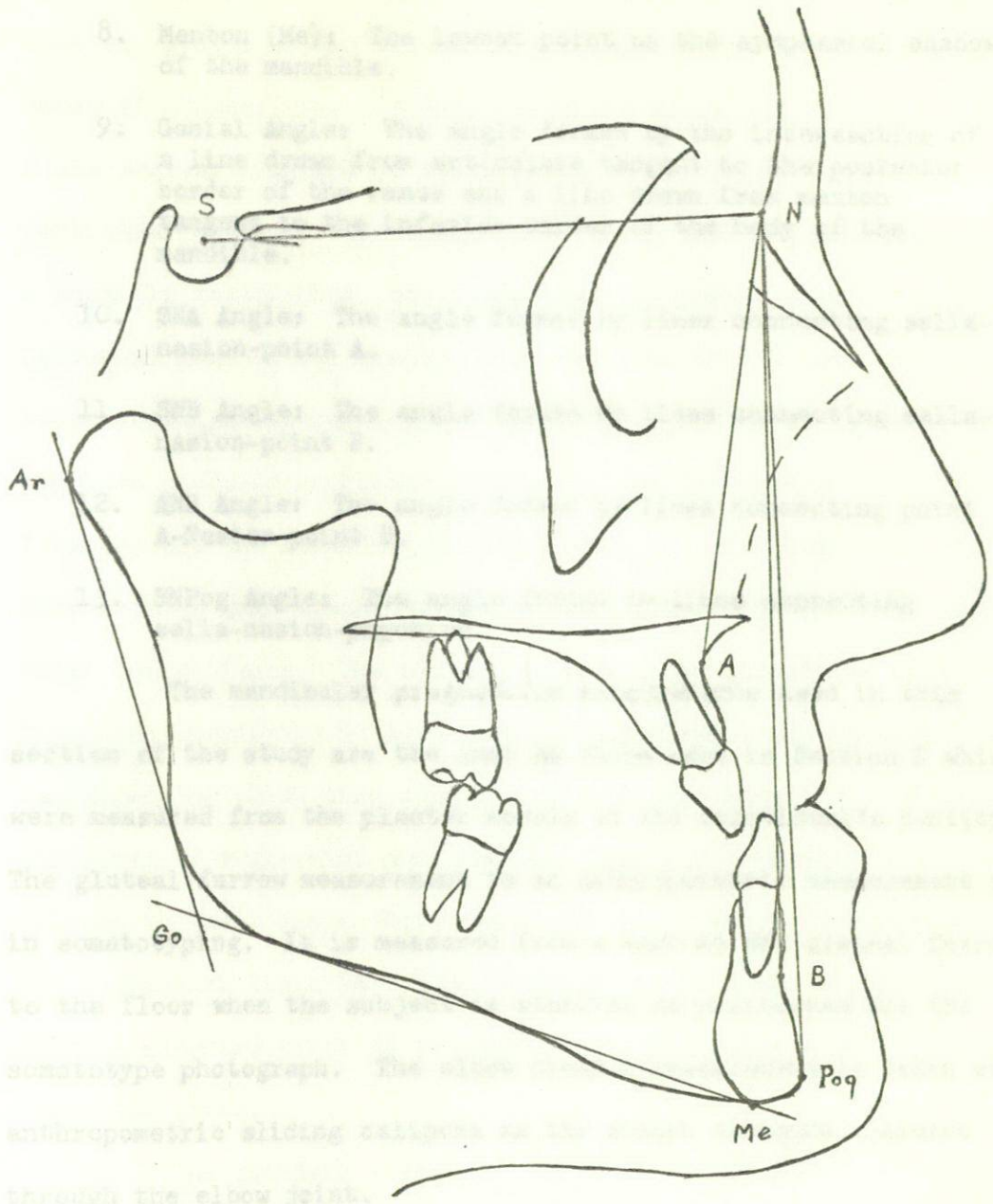


Fig. 7 . Tracing of a cephalometric roentgenograph showing the landmarks and angles used in this study.

condylar processes.

8. Menton (Me): The lowest point on the symphaseal shadow of the mandible.

9. Gonial Angle: The angle formed by the intersection of a line drawn from articulare tangent to the posterior border of the ramus and a line drawn from menton tangent to the inferior border of the body of the mandible.

10. SNA Angle: The angle formed by lines connecting sella-nasion-point A.

11. SNB Angle: The angle formed by lines connecting sella-nasion-point B.

12. ANB Angle: The angle formed by lines connecting point A-Nasion-point B.

13. SNPog Angle: The angle formed by lines connecting sella-nasion-pogonion.

The mandibular prognathism measurements used in this section of the study are the same as those used in Section I which were measured from the plaster models of the individual's dentition. The gluteal furrow measurement is an anthropometric measurement used in somatotyping. It is measured from a mark at the gluteal furrow to the floor when the subject is standing as positioned for the somatotype photograph. The elbow breadth measurement is taken with anthropometric sliding calipers as the widest distance measured through the elbow joint.

A scattergram (Graph 1 through 6) was prepared for each of the 6 statistical comparisons made in this section of the study. The purpose of statistical treatment of the present data is to determine whether any associations exist among the various measurements made on the subjects. The first step in testing the

possibility of such relationships was to make scatter diagrams, that is, graphs of the values of one measurement plotted against those of another, for different pairs of variables. Graphs 1 to 6 are scatter diagrams of those pairs of variables which are of particular interest. In those cases where the diagrams indicated a possible association, the coefficient of correlation $r = \frac{\Sigma (x y)}{\sqrt{\Sigma (x^2) \cdot \Sigma (y^2)}}$ (Although some of the scatter diagrams seem to indicate of curvilinear relationship between the variables, fitting a curved line to the data produced no higher values for the correlation coefficients.) T-values and the resulting probabilities (p) that they were different from zero by only chance variation were then determined for each of these coefficients. The method used was that prescribed by Fisher. There was considered to be a significant association between these variables for which this probability was less than 0.05. Finally, the lines of regression and standard errors of estimate were calculated in those cases where there was some degree of association. The regression lines have been drawn as solid lines on the graphs and one standard error of estimate above and below them indicated by dotted lines.

One standard error, as calculated in Fisher's method, would include 68% of the values plotted for each comparison. The coefficient of correlation (r) can range from +1 to -1 and as the value becomes larger either positive or negative, the correlation becomes stronger.

Findings and Discussion

The statistical comparisons of this section will be discussed in the order in which the scattergrams (Graphs 1 through 6) appear. They are also arranged in order of decreasing significance.

Graph 1 is a comparison of mandibular prognathism with ANB angle. The mandibular prognathism was measured in mm. of forward displacement as shown in Figure 4. Angle ANB is shown on the illustration in Figure 7. As would be expected, there is a strong correlation between these two variables, $r=+.584 \pm 0.13$, the probability $p < 0.01$. This analysis shows that, with variability, as the forward displacement of the lower first molar increases, so does the ANB angle. If the malocclusion had been strictly a dental problem with no skeletal dysplasia, this correlation would not exist. The main purpose of this analysis was to show that all of the subjects in the mandibular prognathism sample were true skeletal malocclusions rather than pseudo or dental malocclusions. The correlation between the two variables is no greater than would be expected in this type of sample.

Graph 2 is a comparison of mandibular prognathism with gluteal furrow percentage. The gluteal furrow percentage is found by dividing the gluteal furrow measurement by body stature. This value is then compared to a standard for each age and sex and a

percentage of the standard is determined.

The gluteal furrow percent in a simplified expression is leg length measured from the gluteal furrow to the floor, adjusted for variations in stature and expressed in percentage of a mean standard for age and sex. This analysis is very interesting because of its unexpected high coefficient of correlation $r=0.511 \pm 0.14$ with a probability of $p < 0.01$. This strong correlation suggests that there may be a relationship between the growth of the long bones of the leg and that of the mandible, or that the bones of the upper face develop at one growth rate and those of the lower face at another. The fact that the gluteal furrow measurement is divided by stature suggested the possibility that the correlation in this analysis may be dependent upon stature. For this reason a partial correlation was calculated between mandibular prognathism and gluteal furrow percentage with stature the excluded variable. This correlation was found to be $r= 0.47$ which is statistically significant, thus the correlation holds irrespective of stature. Stature was then compared directly with mandibular prognathism and no correlation was found.

Graph 3 is a comparison of mandibular prognathism with SNPog angle. The SNPog angle is illustrated in Figure 7. This analysis is similar to that of Graph 1 in that it relates an angle formed between upper and lower facial components with mandibular prognathism. S (Sella) is however, a cranial base landmark rather than an anterior maxillary dental landmark as is point A.

It would be reasonable to assume that approximately the same relationship would exist in Graphs 1 and 3 because they both relate an upper face - lower face angle with mandibular prognathism. As can be seen on the scattergrams of the two comparisons, Graph 1 has a much higher correlation than Graph 3. On Graph 3 the coefficient of correlation is $r = 0.306 \pm 0.18$, the probability $p = 0.10$ (considered not significant). The reason for the loss of significance in this analysis as compared to Graph 1 is probably due to the fact that the angle SNPog incorporates the growth patterns of different bones than does that of angle ANB. This again suggests the difference in growth rates of the various facial components but is by no means conclusive when using a sample of this size and when comparing angles formed crossing several different growth sites.

Graph 4 is a comparison of mandibular prognathism with elbow width percent. The elbow measurement was again adjusted for stature, age, and sex. This comparison was suggested as a cross check on a growth relationship between the mandible and the long bones of the arm. The coefficient of correlation was low $r = 0.255 \pm 0.18$ and the probability $p < 0.2$. The relationship is therefore quite insignificant and related material on joint growth was not available to substantiate the correlation.

Graphs 5 and 6 are similar comparisons relating to the gonial angle of the mandible. The gonial angle is shown in Figure 7. When tracing the cephalometric roentgenographs of this sample it was readily obvious that most of the subjects had exaggerated

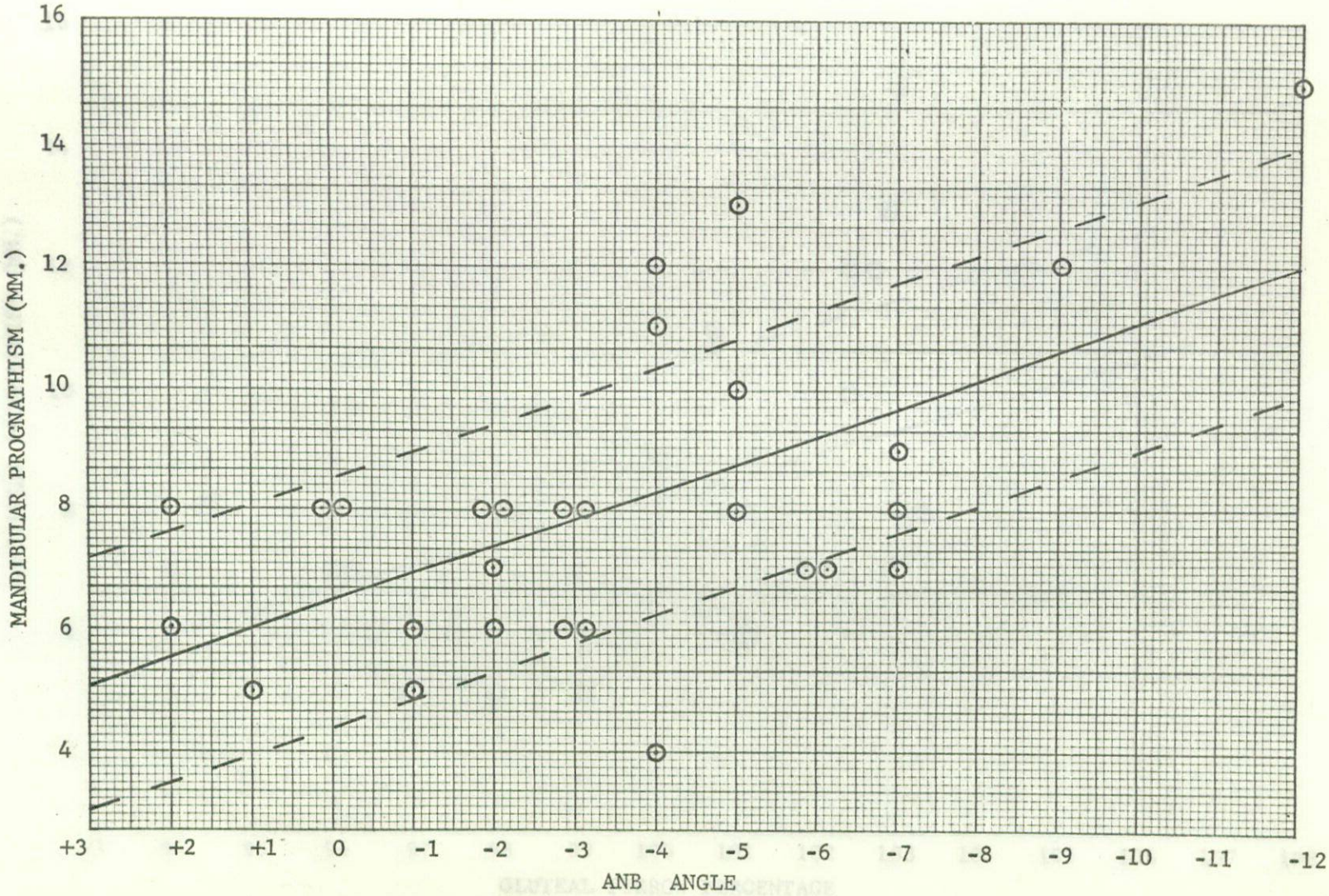
obtuse gonial angles. The measurements of this angle ranged from a low of 120 degrees to a high of 155 degrees, with an average of 135 degrees. Bushra (24) found, on a sample of 40 individuals with excellent occlusion, that the average was 118 degrees with a range of from 111 to 130 degrees. Graph 5 compares ANB angle with gonial angle, the coefficient of correlation r=(-) 0.164 $\pm$ 0.19. The probability p= 0.40 which is an obvious very low correlation and considered insignificant. Chart 6 compares mandibular prognathism with gonial angle. The resulting correlation of this analysis was less than that shown on Graph 5 and was, therefore, not determined. From these two comparisons, it is obvious that even though most Class III malocclusion patients have a greater than average gonial angle, it is not directly related to their degree of mandibular prognathism.

The skeletal ages of the subjects in the mandibular prognathism sample were determined by Dr. Idell Pyle at the Western Reserve University School of Medicine. A percentage of the skeletal age which the individual had attained chronologically was compared to their mandibular prognathism. No significant correlation existed in this analysis.

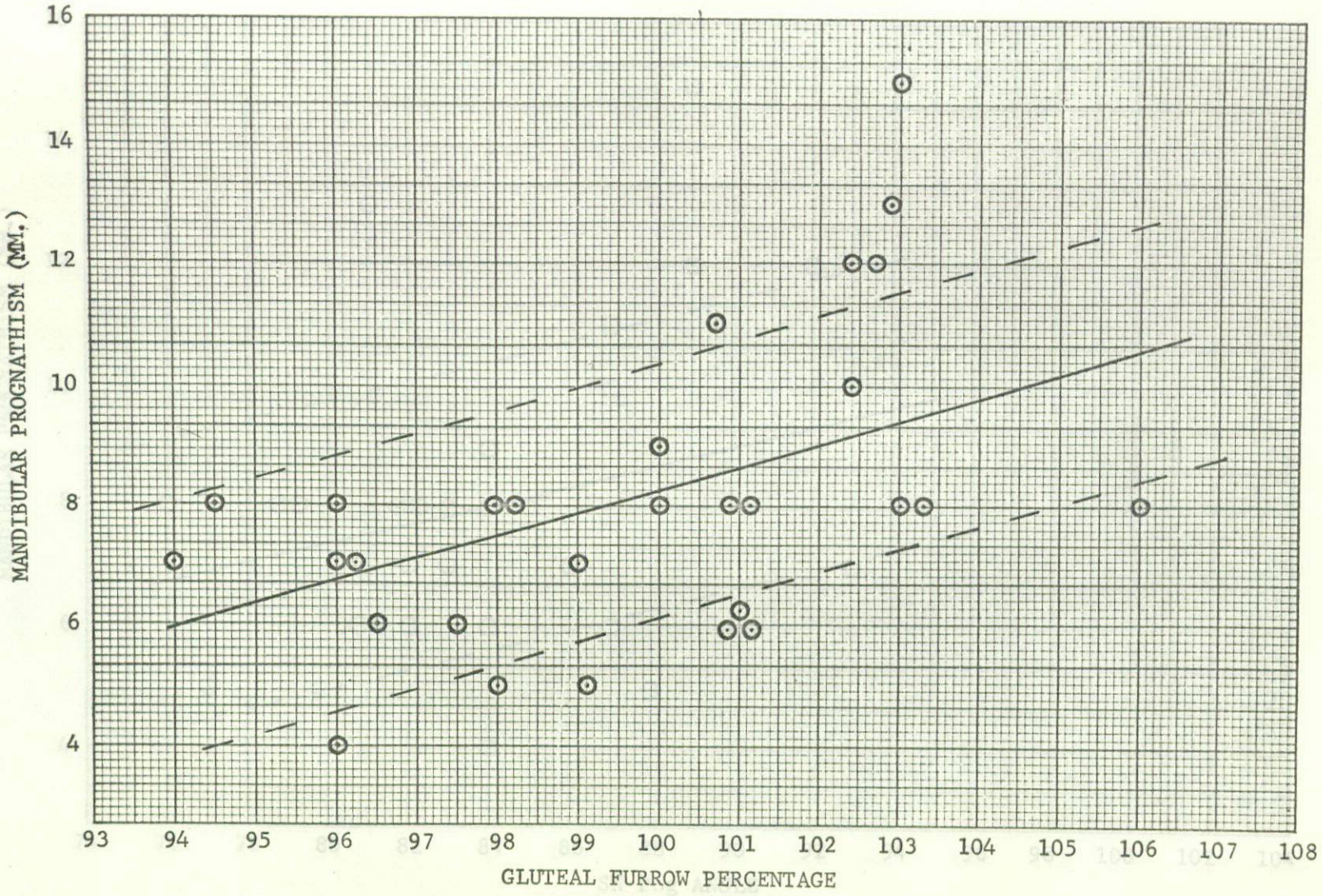
During the initial examination of the subjects in this sample, a personal history was taken. It included information on removal of tonsils and adenoids, mouth breathing, frequency of colds or nasal congestion, ancestral descent and presence of Class III malocclusion in other members of the family. A genetic history or presence of other Class III malocclusions existed in 57% of the

cases and 77% reported a history of mouth breathing. Of this 77%, slightly over half also reported a history of frequent colds, asthma, or sinus problems. The tonsils and adenoids had been removed in 65% of the cases. These percentages are not meant to be significant data because of the small sample size used in this study but they were included to give a more complete analysis of the individual subjects.

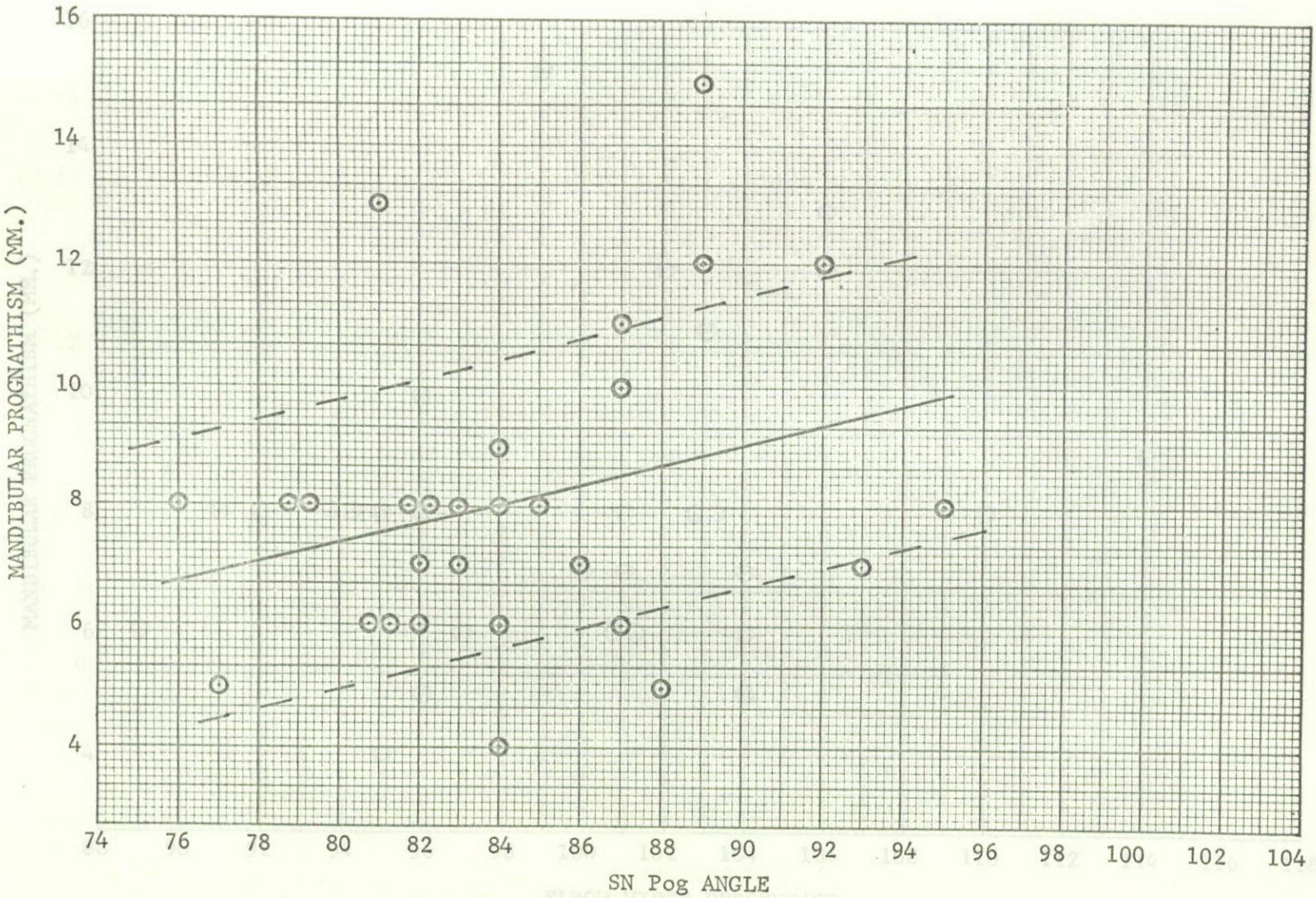
GRAPH 1 A COMPARISON OF MANDIBULAR PROGNATHISM WITH ANB ANGLE



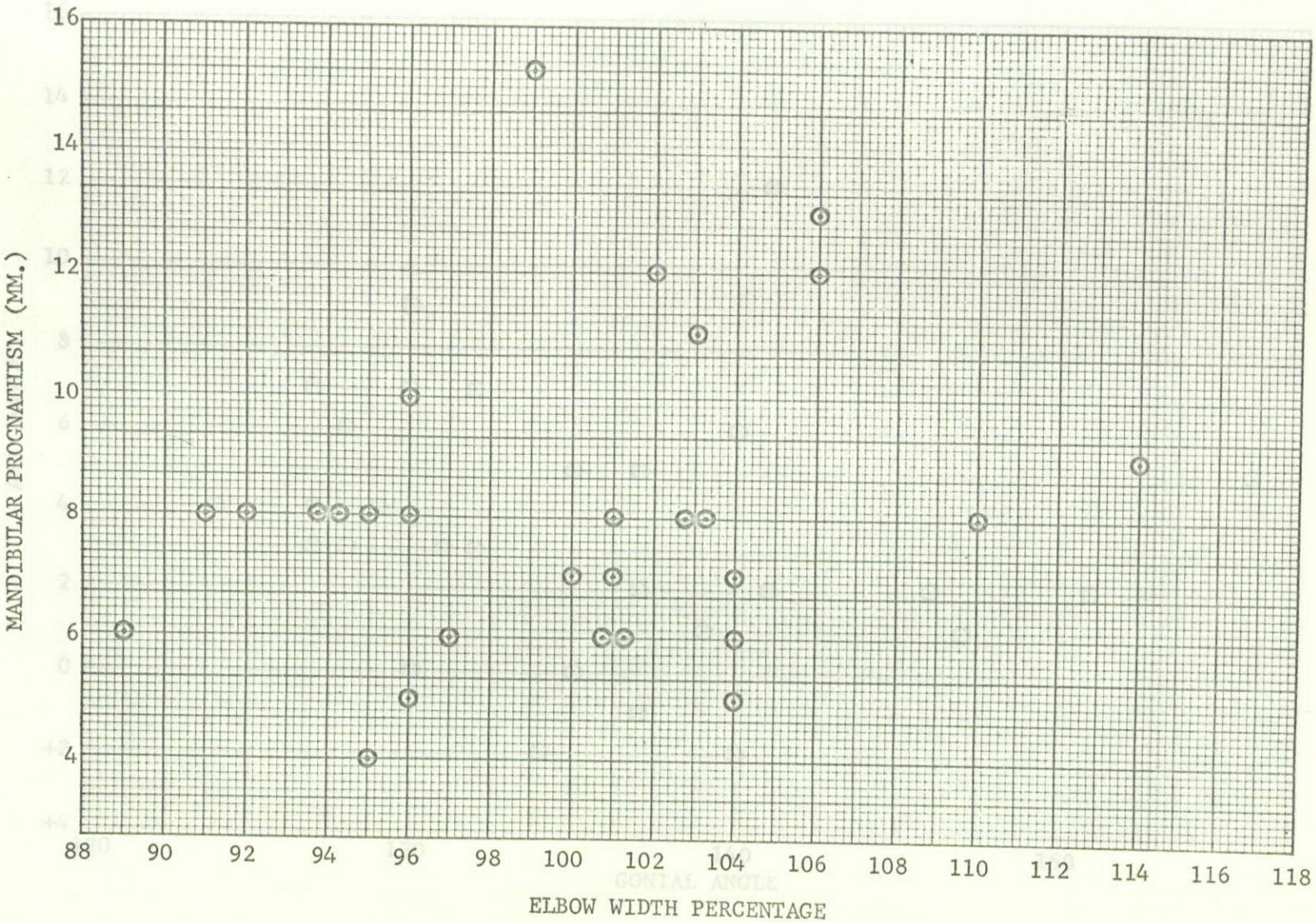
GRAPH 2 A COMPARISON OF MANDIBULAR PROGNATHISM WITH GLUTEAL FURROW PERCENTAGE



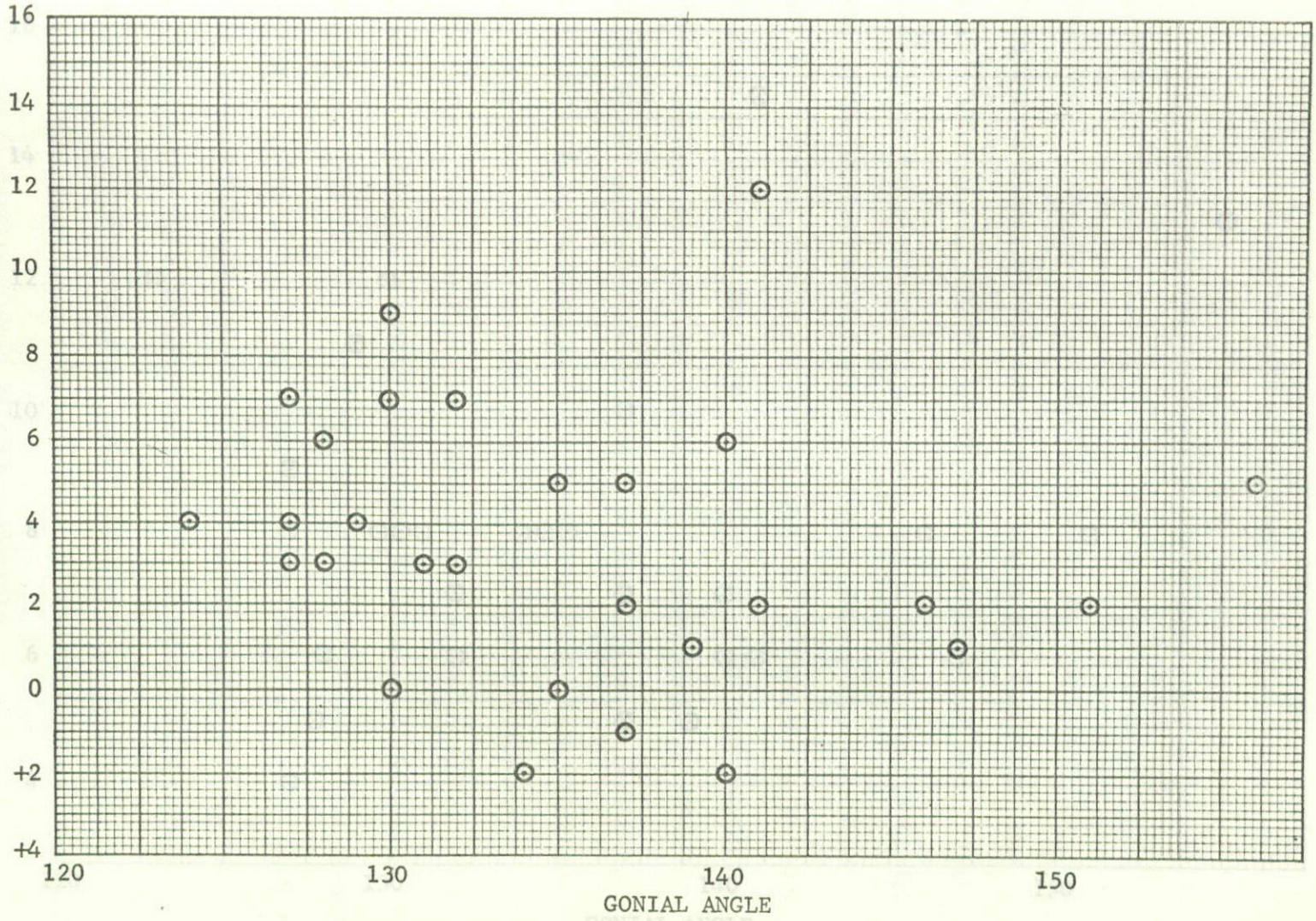
GRAPH 3 A COMPARISON OF MANDIBULAR PROGNATHISM WITH SN Pog ANGLE



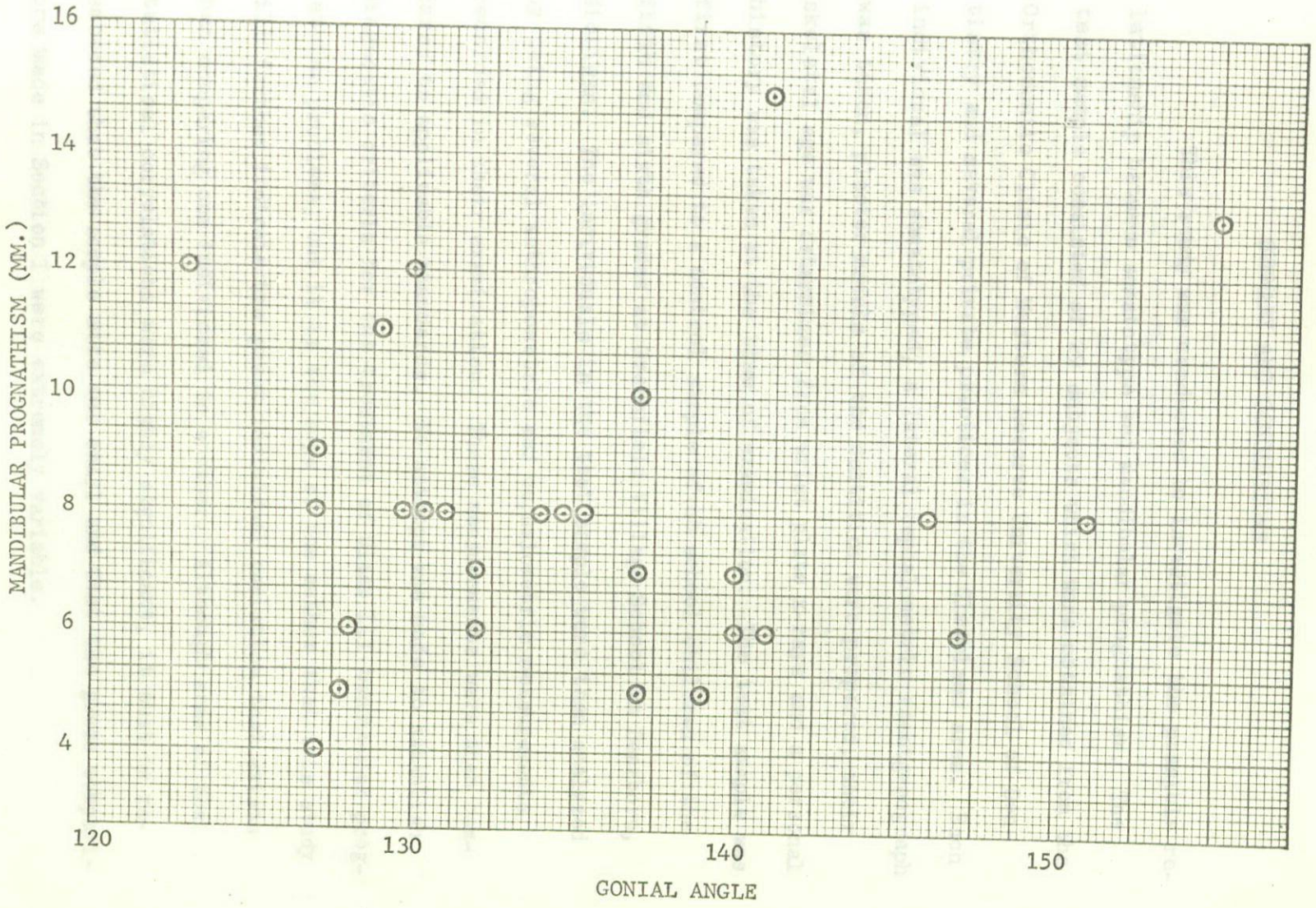
GRAPH 4 A COMPARISON OF MANDIBULAR PROGNATHISM WITH ELBOW WIDTH PERCENTAGE



GRAPH 5 A COMPARISON OF ANB ANGLE WITH GONIAL ANGLE



GRAPH 6 A COMPARISON OF MANDIBULAR PROGNATHISM WITH GONIAL ANGLE



SUMMARY AND CONCLUSIONS

This study was conducted to investigate the possible relationship between somatotype and mandibular prognathism. The test sample consisted of 29 subjects which were obtained from the Orthodontic Clinic of Western Reserve University School of Dentistry and several private practices in the Cleveland area. Each individual was somatotyped, a lateral cephalometric roentgenograph was taken, plaster models of the dentition were prepared, their skeletal age was determined from wrist plate x-rays and a personal history was taken at the time of examination. The test sample was first compared to a control sample of 48 school children of the fifth and sixth grades at Greenfield Village School in Dearborn, Michigan. The individuals in the test sample were then analyzed by using several anthropometric and cephalometric measurements recorded in their examination. These measurements were then compared to applicable standards. No attempt was made to establish diagnostic criteria for the treatment of Class III mandibular prognathism problems, but it is the hope of the author that this study will further indicate the great individual variation that exists when comparing one individual to another. Although some of the statistical correlations were highly significant, it must be remembered that the sample size was small and that the gross comparisons made in Section I were extremely variable.

In analyzing the findings of the study, the following useful conclusions can be made:

1. No direct correlation exists between the individual's somatotype and his degree of mandibular prognathism.

2. The somatotype distribution of the test sample included many more rare and extremely rare somatotypes than would be expected in a normal random sample.

3. The dysplasia ratings (disharmony of body parts) is significantly higher in the test sample than in the control sample.

4. There is a significant correlation between leg length and degree of mandibular prognathism.

5. There is no significant correlation between ANB angle and gonial angle or between mandibular prognathism and gonial angle; however, the gonial angles measured on the test sample were more obtuse than those of normal occlusion samples.

One final conclusion should be discussed from a theoretical viewpoint. It was interesting to note that while the statistical correlation between gluteal furrow percent (leg length) to mandibular prognathism was highly significant, the gluteal furrow percent measurements on the test sample were not abnormally large when averaged against a standard for age and sex. However, the dysplasia ratings were greater (by .93 points) when averaged and compared to the standard or control, but no correlation existed between the dysplasia rating and their mandibular prognathism. From this reasoning, we could theoretically conclude that the dysplasia rating would be the best indicator of a developing mandibular prognathism condition and that the leg length or gluteal furrow percent would give the best estimate of the extent to which it would develop.

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